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DURABILITY OF ADVANCED EMISSION CONTROLS FOR HEAVY DUTY DIESEL AND GASOLINE FUELED ENGINES

R. D. Fleming, et al

Bureau of Mines

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16. ABSTRACT

The objective of the study was to evaluate the use of emission control techniques (that are normally considered on light-duty vehicles) on heavy-duty engines. This report covers results from experimental work in a durability study using engines mounted on dynamometer stands to determine the effectiveness of advanced emission controls on heavy-duty engines over approximately 1,200 hours of operation. One naturally-aspirated, 4-cycle direct-injection, 636 cubic-inch-displacement (CID) diesel engine and one 345-CID gasoline engine were tested on engine dynamometers over about a 1,200 hour accumulation period. The engines were operated on cyclic duty schedules with approximately 40 percent load factors to simulate heavy-duty vehicle driving patterns. The emission control applied to the diesel engine were: (1) injection timing retarded 3 percent crank angle from the production engine setting; (2) two platinum monolithic oxidation catalysts, one for each bank of cylinders; and (3) 10 percent exhaust gas recirculation (EGR). The emission controls used in the gasoline engine were: (1) manifold air injection combined with two platinum pelleted oxidation catalysts, one for each bank of cylinders; and (2) 10 percent EGR. The experimental results and their applicability to the diesel and gasoline engine are presented. Numerous figures and tables are included.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS		b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
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Tests	Gasoline engines	Federal smoke emission tests	21B
Fuels	Gas sampling	Advanced emission controls	
Platinum	Lubricating oils	Heavy-duty engines	
Durability	Chemical analysis	Manifold air injection	
Benzene	Nitrogen oxides	Injection timing retarded	
Hydrocarbons	Exhaust emissions		
Pentanes	Carbon monoxide		
Air Pollution	Air pollution control systems		

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FOREWORD

This report presents a summary of work performed by the Fuels Combustion Research Group, Bartlesville Energy Research Center, Bureau of Mines, for the Environmental Protection Agency (EPA), Mobile Source Pollution Control Program, Characterization and Control Development Branch, Division of Emission Control Technology under Interagency agreement number EPA-IAG 082 (D).

Dr. Jose L. Bascunana was Chief of the Highway Vehicles Section in EPA and John J. McFadden was the Project Officer. The program at Bartlesville was directed by R. W. Hurn, Research Supervisor; Dr. R. D. Fleming, Project Leader, was responsible for the experimental work. T. R. French was responsible for obtaining and calculating emissions data. T. R. Owens and G. D. Garrison, Mechanical Engineering Technicians, operated the engines and analytical equipment during the emission tests. Other technicians who contributed during the accumulation of hours on the engines were: P. E. Cottrell, R. L. Frank, L. S. Maddox, A. C. Pearson, C. L. Purdum, and D. R. Thompson.

DURABILITY OF ADVANCED EMISSION CONTROLS FOR HEAVY DUTY DIESEL AND GASOLINE FUELED ENGINES

I. SUBJECT

This report covers results from experimental work in a durability study using engines mounted on dynamometer stands to determine the effectiveness of advanced emission controls on heavy-duty engines over approximately 1,200 hours of operation.

II. OBJECTIVE

The objective of the study was to evaluate the use of emission control techniques (that are normally considered on light-duty vehicles) on heavy-duty truck engines.

III. SUMMARY AND CONCLUSIONS

One naturally-aspirated, 4-cycle, direct-injection, 636 cubic-inch-displacement (CID) diesel engine and one 345-CID gasoline engine were tested on engine dynamometers over about a 1,200 hour accumulation period. The engines were operated on cyclic duty schedules with approximately 40 percent load factors to simulate heavy-duty vehicle driving patterns.

The emission controls applied to the diesel engine were: (1) Injection timing retarded 3° crank angle from the production engine setting; (2) two platinum monolithic oxidation catalysts, one for each bank of cylinders; and (3) 10 percent exhaust gas recirculation (EGR). The emission controls used on the gasoline engine were: (1) manifold air injection combined with two platinum pelleted oxidation catalysts,one for each bank of cylinders; and (2) 10 percent EGR. The following observations were made and conclusions were drawn as follows:

A. Applicable to the Diesel Engine

The following observations and conclusions concerning emissions of carbon monoxide (CO), hydrocarbons (HC), and oxides of nitrogen (NO_x) as well as specific fuel consumption are based on composite results from the 13-mode cycle procedure (1)*. All references to smoke emission are based on results from the Federal smoke emission test procedure (1).

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* Underlined numbers in parentheses refer to the list of references at the end of this report.

1. Baseline emissions and specific fuel consumption for the standard engine were: CO--5.4 g/bhp-hr; HC--1.8 g/bhp-hr; NO_x--9.8 g/bhp-hr; and fuel consumption --0.453 lb/bhp-hr. Smoke emission was 7 pct for the acceleration mode; 8 pct for the lugging mode; and peak opacity was 16 pct.

2. The application of emission controls resulted in CO and HC reductions from 80 to 90 pct and an NO_x reduction of 45 pct without a measurable increase in fuel consumption. Smoke emission, however, was increased by 3 units during the acceleration mode, 2 units during the lugging mode, and peak smoke was increased by about 5 units.

3. After 1,060 catalyst hours, the catalytic converters were still removing from 80 to 90 pct of the CO and HC.

4. No deterioration (in terms of NO_x reduction) in performance of the EGR system was observed in 1,150 hours of engine operation.

5. A steady increase in smoke emissions over the 1,150 hours of operation was observed. The cause of increase in smoke was partially due to deterioration in injection nozzle performance. Other causes for the increased smoke might be related to changes in the EGR system, however, this could not be substantiated by inspection of the system.

6. Smoke emissions stayed within the Federal smoke limits throughout 1,150 hours of operation with 40 pct load factor on cyclic duty with the exception of three test points. At the 892; 1,138; and 1,198 hour tests the lug smoke exceeded the 15 pct opacity limit by 1, 1, and 2 units, respectively.

7. An inspection of the engine (after complete disassembly) at the end of the accumulation period indicated no abnormal wear conditions due to the emission controls.

The overall results of the study showed that NO_x emissions could be significantly reduced by the use of EGR while maintaining good system durability. The system used an air-cooled heat exchanger designed to introduce recycled exhaust into the intake air stream at a relatively high temperature (approximately 600° F) to prevent heat-exchanger fouling. The system also incorporated automatic EGR cutoff above 90 pct power to prevent deterioration in engine performance in terms of power loss and increased fuel consumption which would have been caused by the limitation of intake air due to the recycling of the relative hot exhaust gas.

If CO or HC emissions were a problem, it appears that catalysts could be used; however, it would require much more extensive testing with various duty cycles before it could be substantiated that catalysts can be used successfully with diesel engines. Emissions of CO and HC from most diesels are not considered a serious problem, therefore, it may not be necessary to consider the use of catalysts at this time.

B. Applicable to the Gasoline Engine

The following observations and conclusions concerning emissions of CO, HC, and NO_x as well as specific fuel consumption are based on composite results from the 9-mode procedure (1). [Note that the 9-mode cycle procedure was modified to use engine torque values rather than manifold vacuum as an indicator for load. See Section V(C) for details.]

1. Baseline emissions and fuel consumption from the gasoline engine were: CO--35 g/bhp-hr; HC--4.1 g/bhp-hr; NO_x--9.9 g/bhp-hr; and fuel consumption--0.717 lb/bhp-hr.

2. The application of emission controls resulted in CO and HC reductions of about 95 pct and an NO_x reduction of about 40 pct with about a 10 pct increase in fuel consumption.

3. The catalytic converters were still converting from 60 to 70 pct of the CO and HC after 1,050 catalyst hours even though there was about 45 pct loss of catalyst.

4. The carburetor had fouled to the extent that idle CO could not be adjusted to specifications after 700 hours of operation. Complete carburetor cleaning was required to correct the problem.

5. The EGR system had fouled to the extent that EGR distribution was upset and light load misfire caused high HC emissions at the end of 1,050 hours of operation. Cleaning of the intake manifold EGR feed passages was required to correct this problem.

The fouling of the carburetor could have been due to lack of a suitable additive in the fuel, however, the fouling of the EGR system was a more serious problem and changes in design would probably be required before more trouble-free operation could be achieved.

The catalytic converters performed well and showed some promise for use in heavy duty service. The design of the exhaust system will be difficult, because, if the catalysts are located too close to the engine overheating of the catalyst will occur; on the other hand if the catalyst are located too far from the engine the catalysts will be slow to warm up.

IV. DESCRIPTION OF TEST EQUIPMENT AND FUELS

A. Engines and Accessory Equipment

One diesel engine and one gasoline engine in the medium to heavy duty class were used in the program. The engines were supplied by two manufacturers who cooperated in the program. In addition, two catalyst manufacturers furnished accessory hardware.

The diesel engine was a 1973 model, naturally-aspirated, open-chamber, four-stroke cycle, 636-CID engine designed for use in vehicles from 24,500 to 60,000 pounds gross vehicle weight. The emission control parameters and/or devices used with this engine were: Injection timing retarded 3° crank angle from standard; exhaust gas recirculation; and two monolithic platinum oxidation catalysts, one for each bank of cylinders. The engine was equipped with prototype low-sac volume fuel injection nozzles to aid in lowering HC emissions.

The EGR system (shown in figure 1) for the diesel engine consisted of two thin plate orifices to control EGR rate, about 6 feet of 1-inch I.D. finned pipe for each bank of cylinders, and an automated valve for EGR cutoff at 90 pct power and above. The system takes exhaust gas upstream of each of the two catalytic converters, the exhaust flows through the finned pipe (which serves as a heat exchanger) and is introduced into the engine air intake stream after passing through the EGR cutoff valve. The cutoff valve is designed to automatically cutoff at about 90 pct power. The cutoff is accomplished by means of an electrical switch which makes contact when the fuel pump rack passes the 90 pct fueling position. The metering orifices were located near the exhaust manifold outlets in a high temperature zone to prevent deposit accumulation that would foul the system.

The following are typical EGR rates for the 13-mode test procedure:

Mode	Speed	Power, pct	EGR rate, pct of intake charge
1	Idle	0	17.6
2	Intermediate	2	12.9
3	"	25	11.6
4	"	50	10.4
5	"	75	9.6
6	"	100	0
7	Idle	0	16.8
8	Rated	100	0
9	"	75	9.8
10	"	50	9.8
11	"	25	10.6
12	"	2	11.0
13	Idle	0	17.6

The metering orifices were sized to give approximately 10 pct EGR at 75 pct power and rated speed. The EGR parameter will be referred to as 10 pct EGR throughout this report. It was anticipated that deposits would collect in the intake ports of the engine if exhaust and crankcase vapors were mixed, therefore, the positive crankcase ventilation hose was disconnected, and the crankcase vapors were vented to the atmosphere.

The gasoline engine was a 345-CID engine designed for use in vehicles from 23,500 to 46,000 pounds gross vehicle weight. The emission controls used on this engine were: Manifold air injection, two platinum pelleted oxidation catalysts, and an EGR system. The engine was equipped with a deceleration modulator to reduce HC emissions during deceleration. The emission control system is shown in figure 2. The manifold air injection system was essentially that normally used on light-duty engines. The two catalytic converters were downflow pancake type and each contained 180 cubic inches of platinum pelleted catalyst. The converters were mounted with 7 feet of 3 inch diameter exhaust pipe between exhaust manifolds and the converter inlets. This length of pipe was necessary so that the catalyst would not be overheated during full power modes. The EGR system was built into the intake manifold and the rate of EGR was controlled by an automatic vacuum actuated valve. The EGR delivery characteristics could be varied by changing the shape and/or size of the valve pintle. The pintle used for this program is arbitrarily referred to as a 10 pct EGR pintle.

The following are EGR rates determined for the modes used in the 9-mode test procedure:

Engine speed, rpm	Power, pct	Manifold vacuum, inches HG	EGR rate, pct of intake charge
700 (Idle)	0	19	1.3
2,000	10	16	11.1
2,000	30	12	11.4
2,000	60	7	8.8
2,000	90	2	1.9

The automatic EGR valve was designed to shut off at idle and full power modes to avoid unacceptable deterioration in engine performance with EGR. It should be noted that the non-zero EGR rate at idle shown in the above table, does not mean that the EGR valve leaked or failed to shut off but, rather is a consequence of natural EGR due to overlapping of intake and exhaust valve timing. Note also, that the manifold vacuums do not correspond exactly with those that are normally used in the 9-mode test procedure. This is because the 9-mode test procedure for this program was run on the basis of engine torque rather than manifold vacuum. This was done because the addition of EGR to the engine would greatly upset the relationship between manifold vacuum and torque output. If the EGR system was deactivated, the 10, 30, 60, and 90 pct power modes would correspond to 19, 16, 10, and 3 inches of Hg vacuum, respectively.

B. Fuels

The diesel fuel used throughout the test program was obtained from a single source. Periodic inspections of the diesel fuel have shown the fuel properties and composition to remain relatively constant. The diesel fuel was substantially equivalent to the specification as called out by the Federal Register (1). The only differences were: The initial boiling point was about 22° F low; the 10 pct point was about 14° F low; and total sulfur was 0.14 pct as compared to a minimum of 0.2 pct in the specifications. These differences are judged not to be significant in terms of affecting the results of this experimental program.

The gasoline used in the program was Indolene motor fuel HO III (procured from American Oil Company). Lead and phosphorus were added to the gasoline to meet specifications called for by EPA. The specifications were 0.03 to 0.05 g/gal lead and 0.002 to 0.003 g/gal phosphorus. The inspection data for the fuels used are as follows:

	Diesel fuel	Gasoline
Gravity, °API	36.0	59.1
Reid vapor pressure, psi	-	8.7
Research octane number	-	97.1
Cetane index	44.0	-
Lead, g/gal	-	0.03
Phosphorus, g/gal	-	0.0025
Sulfur, wt pct	0.14	0.017
Distillation, °F:		
Initial boiling point	318	94
10 pct evaporated	386	133
50 pct evaporated	472	224
90 pct evaporated	568	323
End point	609	412
Composition, vol pct, FIA:		
Aromatics	31	33
Non-aromatics	69	67

C. Dynamometer Equipment

The diesel engine tests were conducted using a 350 horsepower eddy-current dynamometer. The dynamometer was fitted with an inertial flywheel to facilitate running the smoke tests.

The gasoline engine tests were conducted using a 175 horsepower eddy-current dynamometer that was coupled to an eddy-current motor drive to provide motoring capability for the emission test procedures.

V. EXPERIMENTAL PROCEDURES

A. Exhaust Sampling and Analysis for Gaseous Emissions

Exhaust gas was sampled from both the gasoline and diesel engines about 7 feet downstream of the catalytic converters. For those tests where exhaust was sampled upstream of the catalytic converters, the exhaust was sampled at the converter inlets. A schematic of the sampling and analytical system used for the diesel and gasoline engine tests is shown in figure 3. The sampling line was maintained at 350° F for both the diesel and gasoline engine tests. In addition to the instruments shown, an oxygen analyzer was used in the gasoline engine tests.

Carbon monoxide and carbon dioxide (CO_2) were measured by nondispersive infrared (NDIR); total NO_x by chemiluminescence; oxygen (O_2) by a polarographic instrument; and total HC by flame ionization detection (FID). Two CO analyzers were used which provided four different ranges of measurement. The ranges available were: 0-0.1 pct CO; 0-0.5 pct CO; 0-1.0 pct CO; and 0-5.0 pct CO.

B. Smoke Measurements for the Diesel Engine

An EPA smokemeter of the type described in the Federal Register (1) was used in all tests to measure smoke. The test procedure was run in accordance with paragraph 85.874-11 (1). There was about 18 feet of exhaust piping between the catalytic converters and the smokemeter. No muffler was used downstream of the catalytic converters because the use of a conventional muffler would result in exhaust back pressure in excess of that recommended by the engine manufacturer.

C. Engine Cycle Procedures

Three different engine cycle procedures were used in the test program. A 23-mode procedure was used for baseline tests for both the diesel and gasoline engines. In addition, the 9-mode procedure (1) was used for baseline tests involving the gasoline engine. Composite values for emissions and fuel consumption for the diesel engine were calculated for the 13-mode procedure from data generated in the 23-mode procedure. This was possible because the 23-mode procedure contained all of the engine modes that are used in the 13-mode procedure.

The 23-mode procedure is described as follows:

Mode	Engine speed	Percent load	Weighting factor, pct
1	Idle	0	7.0
2	Intermediate	2	6.0
3	"	8	6.0
4	"	18	5.0
5	"	25	3.0
6	"	50	6.0
7	"	75	0
8	"	82	4.0
9	"	92	0
10	"	100	0
11	Idle	0	7.0
12	Intermediate	Closed throttle	12.0
13	High	100	2.5
14	"	92	5.5
15	"	82	3.5
16	"	75	6.0
17	"	50	6.0
18	"	25	0
19	"	18	6.5
20	"	8	0
21	"	2	0
22	Idle	0	8.0
23	High	Closed throttle	6.0

The engine speed is defined as follows:

	Engine type	
	Diesel	Gasoline
Intermediate	Peak torque speed or 60 pct rated, whichever is greatest	1,200 rpm
High	Rated speed	2,300 rpm

The emission data were read during the third minute after the beginning of each mode. A maximum of 10 minutes is allowed in each mode to take all necessary data.

The origin of the 23-mode test schedule operating speeds, loads, and weighting factors was from a computer analysis of truck and bus survey data taken by Ethyl Corporation in 1963. The computer analysis and subsequent formulation of the test schedule was performed by EPA's Procedure Development Branch, Division of Emission Control Technology.

Following the baseline tests, all further testing was done using the 13-mode procedure (1974 Federal test procedure) as given in the Federal Register (1) for the diesel engine and the 9-mode procedure (1) for the gasoline engine.

The 9-mode cycle procedure was slightly modified from that called for in the Federal Register. The load was determined by torque readout rather than manifold vacuum. The torques used were as follows:

Torque, pct	Manifold vacuum for standard engine without EGR, in. Hg	Manifold vacuum for engine equipped with EGR, in. Hg
10	19	16
30	16	12
60	10	7
90	3	2

The torque reference was used rather than manifold vacuum because the relationship between manifold vacuum and torque changed with the addition of EGR to the emission control package as shown above.

D. Engine Duty Schedules for Durability Study

After performing baseline tests for each of the engines, the engines were operated on a 21-hour per day duty schedule for the purpose of accumulation of hours on the engines and associated emission control hardware.

Air supplied to the engines during the entire accumulation was conditioned to control temperature near 70° F. The intake restriction and exhaust backpressure for the diesel engine was held at the maximum allowed by the manufacturer during the accumulation.

The duty schedules were arranged so that each engine would alternately run at steady-state and on cycle duty at hourly intervals.

The duty schedule for the engine was as follows:

DUTY SCHEDULE FOR ACCUMULATION OF HOURS

Time	Diesel engine		Gasoline engine	
	Steady state No.	Mode	Steady state No.	Mode
9:00 am - 10:00 am	1	1,700 rpm & 25 pct load	-	Cycle
10:00 am - 11:00 am	-	Cycle	1	2,800 rpm & 75 pct load
11:00 am-12:00 noon	2	2,800 rpm & 95 pct load	-	Cycle
12:00 noon-1:00 pm	-	Cycle	2	3,600 rpm & 95 pct load
1:00 pm - 2:00 pm	3	1,400 rpm & 10 pct load	-	Cycle
2:00 pm - 3:00 pm	-	Cycle	3	2,000 rpm & 25 pct load
3:00 pm - 4:00 pm	4	1,700 rpm & 50 pct load	-	Cycle
4:00 pm - 5:00 pm	-	Cycle	4	2,800 rpm & 50 pct load
5:00 pm - 6:00 pm	5	2,200 rpm & 95 pct load	-	Cycle
6:00 pm - 7:00 pm	-	Cycle	5	3,600 rpm & 75 pct load
7:00 pm - 8:00 pm	6	2,800 rpm & 75 pct load	-	Cycle
8:00 pm - 9:00 pm	-	Cycle	-	Shut-down
9:00 pm - 10:00 pm	-	Shut-down	-	Cycle
10:00 pm - 11:00 pm	-	Cycle	6	2,000 rpm & 75 pct load
11:00 pm-12:00 Midnight	7	1,400 rpm & 25 pct load	-	Cycle
12:00 Midnight-1:00 am	-	Cycle	7	2,800 rpm & 95 pct load
1:00 am - 2:00 am	8	1,700 rpm & 75 pct load	-	Cycle
2:00 am - 3:00 am	-	Cycle	8	3,600 rpm & 50 pct load
3:00 am - 4:00 am	9	2,800 rpm & 50 pct load	-	Cycle
4:00 am - 5:00 am	-	Cycle	9	2,000 rpm & [illegible]0 pct load
5:00 am - 6:00 am	10	2,200 rpm & 75 pct load	-	Cycle
6:00 am - 7:00 am	-	Cycle	10	3,600 rpm & 25 pct load
7:00 am - 9:00 am	-	Shut-down	-	Shut-down

The cycle portion of the duty schedule for the diesel engine is defined as follows:

Mode	Speed, rpm	Load, pct	Cumulative time, min.
1	1,700	0	5
2	"	25	10
3	"	50	15
4	"	75	20
5	"	100	25
6	Idle (600 rpm)	0	30
7	2,800	100	35
8	"	75	40
9	"	50	45
10	"	25	50
11	"	0	55
12	Idle (600 rpm)	0	60

The cycle portion of the duty schedule for the gasoline engine is defined as follows:

Mode	Speed, rpm	Load, pct	Cumulative time, min.
1	Idle (700 rpm)	0	5
2	1,800	10	10
3	2,500	90	15
4	2,000	30	20
5	Idle (700 rpm)	0	25
6	1,800	30	30
7	1,200	60	35
8	1,800	30	40
9	Idle (700 rpm)	0	45
10	1,800	60	50
11	3,200	90	55
12	2,000	0	60

The method of alternating between steady-state operation and cyclic duty is depicted graphically in figure 4 for both engines.

The overall load factors when combining both the steady-state and cycle portions of the duty schedule were estimated to be 43 pct for the diesel engine and 40 pct for the gasoline engine. These load factors are defined as:

$$\text{Load factor} = \frac{\text{average fuel rate (actual)}}{\text{fuel rate at 100 pct load \& rated speed}} \times 100$$

E. Experimental Design

The test program was essentially in two parts: (1) Baseline tests where three replicate emission tests were made with each engine equipped with and without emission controls and (2) a durability study with the engines equipped with emission controls where emission tests were conducted at about 125 hour intervals during a 1,200 hour accumulation. Following the accumulation, tests were made to determine the cause for any drift in emissions that were observed during the accumulation period.

During the accumulation period, oil samples were collected at each oil drain period for analysis. The oil samples were analyzed for metal elements that included wear metals (Fe, Al, Cu, Cr, Si, Pb, and Mo) by atomic absorption . Viscosity determinations (ASTM D-445) were made at 100° and 210° F and the samples were also analyzed for pentane and benzene insolubles (ASTM D893-69). In addition, the engine manufacturers analyzed the same oil samples and provided data for comparison.

VI. EXPERIMENTAL RESULTS

A. Applicable to the Diesel Engine

1. Baseline Data

Three replicate emission tests (23-mode cycle) were run with the engine adjusted in accordance with the manufacturer's specifications. The engine was equipped with an emission control package which included: Injection timing retarded 3°; two platinum monolithic catalysts; and 10 pct EGR. Three replicate emission tests (23-mode cycle) were made with the engine equipped with the emission controls.

Results from the emission tests with and without emission controls are summarized in table 1. The modal data for these tests are given in appendix A.

Note that in the text tables and appendix tables, the composite cycle gaseous emissions and fuel consumption are expressed as brake specific emissions and brake specific fuel consumption. For example, brake specific carbon monoxide emission is designated BSCO and brake specific fuel consumption is designated as BSFC.

TABLE 1. - Baseline gaseous emissions for the diesel engine with and without emission controls

Engine description	Test No.	23-Mode cycle				13-Mode cycle			
		Emissions, g/bhp-hr			BSFC, lb/bhp-hr	Emissions, g/bhp-hr			BSFC, lb/bhp-hr
		BSCO	BSHC	$BSNO_2$		BSCO	BSHC	$BSNO_2$	
Adjusted to manufacturer's specifications	1	4.72	1.82	9.97	0.455	5.35	1.86	9.91	0.454
	2	4.92	1.81	9.59	.453	5.52	1.87	9.70	.454
	3	5.10	1.78	9.66	.458	5.31	1.82	9.76	.452
	Average	4.91	1.80	9.74	.455	5.39	1.85	9.79	.453
Equipped with emission controls 1/	1	0.58	0.61	5.42	0.464	0.38	0.40	5.40	0.452
	2	1.00	.69	5.24	.466	.59	.47	5.37	.459
	3	1.00	.63	5.30	.466	.57	.42	5.31	.456
	Average	.86	.64	5.32	.465	.51	.43	5.36	.456

1/ Injection timing retarded 3° crank angle from standard, two platinum monolithic catalysts, and 10 pct EGR.

A similar diesel engine (same model) was tested in a previous parametric study (2) and similar emission controls were applied to that engine. The results of the previous program are summarized as follows:

Engine	23-Mode cycle				13-Mode cycle			
	Emissions, g/bhp-hr			BSFC,	Emissions, g/bhp-hr			BSFC,
	BSCO	BSHC	$BSNO_2$	lb/bhp-hr	BSCO	BSHC	$BSNO_2$	lb/bhp-hr
Standard engine.	5.54	2.82	8.46	0.446	5.93	2.90	8.27	0.445
Engine equipped with emission controls.......	2.43	1.80	3.65	.472	1.93	1.79	4.18	.476

Comparison of the above results with the results of the present program (table 1) shows the HC emission from the previous standard engine was about 1 to 1.1 g/bhp-hr higher than that of the standard engine used in the present program. The lower HC emission for the present engine is a result of the prototype (low-sac volume) injection nozzles which were not available in the previous program. Carbon monoxide and HC conversion efficiencies for the present system were higher than those of the previous program, because the catalysts (used in the present program) were designed to more closely match the engine requirements. Oxides of nitrogen control (based on the 23-mode cycle) achieved in the previous program was a 57 pct reduction while fuel consumption increased about 6 pct. In the present system, NO_x was reduced by 45 pct while fuel consumption increased by only 2 pct. Based on the 13-mode cycle, the application of the emission controls reduced NO_x by 49 pct in the previous program with a 7 pct increase in fuel consumption while in the present work NO_x was reduced by 45 pct and the increase in fuel consumption was less than 1 pct. The apparent higher level of NO_x control in the previous work as compared to the present work can probably be attributed to differences in the EGR system. In the previous setup, the exhaust gas was cooled with a liquid/gas heat exchanger which cooled the exhaust gas to about 200° F before it was returned to the engine intake and exhaust gas was cutoff at full load by means of a manual valve. Since the present system was set up for a durability study, a finned pipe was used to cool the exhaust gas rather than a liquid/gas heat exchanger and the exhaust gas was at a somewhat higher temperature when it entered the intake stream and exhaust cutoff was accomplished by an automatic valve. The present heat exchanger setup was used to avoid fouling that would have occurred if a conventional heat exchanger was used.

Summarizing the results of the present baseline study: The application of emission controls reduced CO 82 pct, HC 64 pct, and NO_x 45 pct with a 2 pct increase in fuel consumption when based on 23-mode cycle results. In terms of the 13-mode cycle, the emission controls reduced CO 90 pct, HC 77 pct, and NO_x 45 pct with less than 1 pct penalty in fuel consumption.

Smoke emissions for the standard engine and with emission controls are summarized in table 2. Results show about a 3 pct opacity increase in acceleration smoke, a 2 pct opacity increase in lugging smoke, and about a 5 pct opacity increase in peak smoke with the application of the emission controls. The increase in lugging smoke is probably due solely to retarded injection timing, since EGR is cut off at about 90 pct of full rack position. The acceleration and peak smoke can be affected by EGR because the cutoff valve is open at the start of acceleration and closes sometime during the acceleration mode. The signal for cut off occurs as soon as the fuel rack passes the 90 pct position, but, the pneumatic cutoff valve responds on the order of about two seconds. Thus, the increase in acceleration smoke and peak smoke with emission controls is probably the result of both retarded timing and EGR.

TABLE 2. - Baseline smoke emissions for the diesel engine with and without emission controls

Engine description	Test No.	Smoke values, pct opacity		
		Acceleration mode, "A"	Lugging mode, "B"	Peak opacity, "C"
Adjusted to manufacturer's specifications	1	6	7	15
	2	8	9	17
	3	7	7	16
	Avg.	7	8	16
Equipped with emission controls 1/	1	10	11	18
	2	10	9	22
	3	11	10	22
	Avg.	10	10	21

1/ Injection timing retarded 3° crank angle, two platinum monolithic catalysts, and 10 pct EGR.

2. Durability Tests

After baseline tests were run with the engines equipped with emission controls, the diesel engine was put on the 21-hour per day duty schedule outlined in section V(D) and shown in figure 4. An emission test was made at approximately 125-hour intervals throughout the accumulation period. The accumulation was started before all the emission control hardware was available, therefore, the catalytic converters were installed about 97 hours after the EGR system was installed on the engine. After the catalytic converters were installed, the emission tests were run such that samples were taken before and after the catalyst during each mode. That is, during the 10 minutes in each mode of the 13-mode cycle, exhaust was sampled before the catalyst for the first five minutes and then sampled after the catalyst during the remaining five minutes of the mode. In this way, a composite value for the 13-mode cycle could be determined for the system with and without catalytic converters.

Results (in terms of the 13-mode composite values) from the durability study over about a 1,160 hour accumulation period are shown in figures 5 through 8. The complete test results including modal data are given in appendix B.

Carbon monoxide emission (figure 5) from the engine throughout the accumulation was in the 5 to 7 g/bhp-hr range with a slight trend upward with increased operating time. The catalysts were converting about 90 pct of the CO at the start of the program and were still converting about 88 pct of the CO after 1,160 hours of operating time. At the end of the accumulation, new injection nozzles were installed just prior to the final test point. Results (figure 5) from the last test indicate that increase in CO with increased operating time may have been associated with deterioration in nozzle performance. Hydrocarbon emission (figure 6) ranged from 1.3 to 1.8 g/bhp-hr during the accumulation period with most of the values in the 1.5 to 1.6 g/bhp-hr range. The catalysts showed a slight deterioration in HC conversion efficiency with increased operating time. The HC conversion efficiencies were about 70 pct at the start of the accumulation and were on the order of 60 pct at the end of 1,160 hours (1,064 hours on the catalysts). Oxides of nitrogen emissions (figure 7) were relatively stable throughout the accumulation which indicates that the EGR system performed well throughout the program. Specific fuel consumption (figure 8) ranged from 0.439 to 0.474 lb/bhp-hr throughout the 1,160 hours of accumulation. It is interesting to note that the average fuel consumption (for the engine equipped with emission controls) of 0.454 lb/bhp-hr for the entire accumulation period compares to the standard engine value of 0.453 lb/bhp-hr (table 1). This suggests that about 45 pct reduction in NO_x was achieved without a penalty in specific fuel consumption. This result, however, is based on 13-mode cycle data and may not be true for other operating cycles.

Smoke emissions (figure 9 and table 3) increased with operating time. Because smoke emissions were observed to increase over the accumulation period, additional work was done to try to isolate the cause of the smoke deterioration. The injection timing was checked and was found to have drifted from 3° retarded to 3.5° retarded. The injection timing was reset to 3° retarded and additional smoke tests were run. In addition, new injection nozzles were installed to determine any deterioration in nozzle performance. The results of additional tests are as follows:

TABLE 3. - Smoke emission from the diesel engine during accumulation of hours

Engine description	Cumulative time, hours			Smoke values, pct opacity		
	Engine	EGR and retarded timing	Catalysts	"A"	"B"	"C"
EGR & retarded timing only	49	0	-	9	7	23
	131	82	-	8	8	18
EGR, retarded timing and catalysts	146	97	0	10	11	18
	213	164	67	10	9	22
	214	165	68	11	10	22
	337	288	191	12	11	23
	472	423	326	14	13	24
	528	479	382	13	12	25
	652	603	506	15	15	29
	786	737	640	15	15	28
	892	843	746	14	16	24
	1,021	972	875	17	14	33
	1,138	1,089	992	16	16	28
	1,198	1,149	1,052	17	17	30
	1,207[1]	1,158	1,061	13	14	23

[1] Install new injection nozzles and reset injection timing from 3.5° retarded to 3° retarded.

	Smoke values, pct opacity "A"	"B"	"C"
Baseline smoke with emission controls	10	10	21
At end of accumulation	17	17	30
After resetting injection timing	16	16	29
After installing new injection nozzles	13	14	23

These results indicate much of the deterioration in smoke emission was due to deterioration in injection nozzle performance. Another possible cause for increase in smoke for the acceleration mode and peak smoke might be changes in response of the automatic EGR cutoff valve during the accumulation of hours. This could not be checked, however, because response time was not determined at the start of the program.

3. Results of Oil Analysis

A premium multigrade 10W-30 lubricating oil was used in the diesel engine throughout the accumulation of hours. The used oil was analyzed for wear metals, viscosity, and pentane and benzene insolubles. Oil changes were at about 150-hour intervals.

The results of analysis for elements including wear metals are given in table 4 and compared with results from the engine manufacturer. Pentane and benzene insolubles are given in table 5 and viscosities in table 6.

All items covered by the oil analysis were considered normal except for aluminum and iron analysis. Aluminum concentration was high in some of the samples and, in general, iron concentrations were slightly high. These high concentrations would suggest unusual wear conditions, but this was not substantiated by a teardown inspection at the end of the program (see the following section).

4. Results of Engine Teardown Inspection

After completing the durability study, the engine was returned to the manufacturer for inspection. The engine was completely disassembled and the following items were inspected:

TABLE 4. - Elemental analysis of a 10W-30 oil used in the diesel engine

	Engine hours	Oil Hours	Analysis by Bureau of Mines (Atomic absorption)							Analysis by engine manufacturer (Emission spectroscopy)						
			Element, ppm by weight							Element, ppm by weight						
			Fe	Cr	Al	Mo	Pb	Si	Cu	Fe	Cr	Al	Mo	Pb	Si	Cu
New oil..			1	0	0	0	0	1	1	<10	<10	<10	<10	<25	<10	<10
Used oil.	199	150	146	3	41	25	42	19	14	135	<10	40	12	<25	18	<10
	342	143	170	3	33	24	55	11	8	135	<10	33	11	30	17	<10
	504	162	217	3	44	18	45	5	9	165	<10	33	12	45	19	<10
	656	152	177	3	46	24	28	17	7	140	<10	30	12	40	19	<10
	822	162	167	3	23	18	40	16	6	125	<10	25	11	45	19	<10
	972	150	142	1	42	11	43	16	7	100	<10	10	10	31	31	<10
	1,124	152	127	2	53	12	30	16	7	110	<10	20	12	30	13	<10

TABLE 5. - Pentane and benzene insolubles for a 10W-30 oil used in the diesel engine

	Engine hours	Oil hours	Analysis by Bureau of Mines (ASTM D893)		Analysis by engine manufacturer (ASTM D893)	
			Pentane insolubles, weight pct	Benzene insolubles, weight pct	Pentane insolubles, weight pct	Benzene insolubles, weight pct
New oil..			-	-	-	-
Used oil.	199	150	0.9	0.5	1.5	0.9
	342	143	1.3	.7	2.0	1.4
	504	162	2.1	1.7	3.0	1.9
	656	152	1.7	1.1	2.7	1.7
	822	162	1.9	1.2	2.5	1.7
	972	150	1.6	.7	2.0	1.4
	1,124	152	1.8	1.0	2.3	1.7

TABLE 6. - Viscosity of used oil from the diesel engine (10W-30 oil)

	Engine hours	Oil hours	Analysis by Bureau of Mines (ASTM D445)		Analysis by engine manufacturer (ASTM D445)
			Kinetic viscosity, cs		Kinetic viscosity, cs
			100°F	210° F	210° F
New oil....	-	-	64.01	10.98	10.88
Used oil...	199	150	62.55	9.87	9.56
	342	143	66.29	10.15	9.88
	504	162	63.30	9.94	9.65
	656	152	63.55	10.03	9.79
	822	162	63.95	10.03	9.70
	972	150	62.10	10.90	10.35
	1,124	152	63.44	10.06	10.08

1. Pistons
2. Rings
3. Cylinder bores
4. Intake ports
5. Valve stems
6. Valve guide bores
7. Bearings
8. Crankshaft

The intake ports had a thin layer of carbon buildup on the walls but was not of sufficient quantity to be harmful. The measurements of the pistons, rings, and bores indicated normal wear rates for the number of hours on the engine. It was concluded that the engine exhibited no detrimental effect from the use of the emission controls.

The injection nozzles were tested and the valve opening pressures were below specifications. They were prototype nozzles and design changes can solve this problem. The low opening pressures of the nozzles were, in part, responsible for the increase in smoke with accumulation of hours as was previously discussed.

A. Applicable to Gasoline Engine

1. Baseline Data

The gasoline engine was mounted on the dynamometer stand and was run for approximately 14 hours on a break-in schedule recommended by the engine manufacturer. The engine parameters were adjusted to the manufacturer's specifications and three replicate 23-mode cycle tests and three replicate 9-mode cycle tests were run. In this initial configuration the engine had no EGR, and no manifold air injection, but was equipped with a deceleration modulator. After these initial baseline tests, the engine was equipped with emission controls which included: (1) manifold air injection, (2) two 180-cubic inch catalytic converters containing platinum pelleted catalyst, and (3) an EGR system. Two replicate 23-mode tests were run and three replicate 9-mode tests were run after installing the emission controls.

The baseline data for the standard engine and the engine equipped with emission controls are summarized in table 7. Additional data for these tests including modal data are given in appendix C.

TABLE 7. - Baseline emissions for the gasoline engine with and without emission controls

Engine description	Test No.	23-Mode cycle				9-Mode cycle			
		Emissions, g/bhp-hr			BSFC, lb/bhp-hr	Emissions, g/bhp-hr			BSFC, lb/bhp-hr
		BSCO	BSHC	BSNO$_2$		BSCO	BSHC	BSNO$_2$	
Adjusted to manufacturer's specifications	1	47.8	7.25	8.57	0.691	33.4	4.11	10.0	0.702
	2	42.1	8.14	9.20	.697	36.1	3.98	10.1	.737
	3	43.4	8.84	9.20	.696	35.5	4.31	9.48	.713
	Avg.	44.4	8.08	8.99	.695	35.0	4.13	9.86	.717
Equipped with emission controls 1/	1	8.87	0.36	6.47	0.771	1.15	0.11	5.92	0.795
	2	8.14	.47	7.62	.764	.95	.12	6.04	.793
	3	-	-	-	-	1.19	.26	5.13	.775
	Avg.	8.50	.42	7.04	.768	1.10	.16	5.70	.788

1/ Standard ignition timing, two 180-cubic inch catalytic converters with platinum pelleted catalysts, and 10 pct EGR.

Comparison of results between the engine equipped with emission control and the standard engine shows that the emission control package reduced CO by about 81 pct, HC by about 95 pct, and NO$_x$ by about 22 pct while specific fuel consumption increased by about 10 pct when based on the 23-mode cycle. When based on the 9-mode test, the CO reduction was 97 pct, the HC reduction 96 pct, and NO$_x$ reduction 42 pct with a 10 pct increase in fuel consumption. It is evident that the "indicated" performance of a particular emission control package is dependent on the type of test cycle. It is believed that the differences noted here between the 23-mode and 9-mode procedures are related, to a large extent, to the difference in weighting factors for the two procedures. Since the 9-mode cycle is the standard procedure, the remaining tests throughout the test program were conducted using the 9-mode procedure.

2. Durability Study

Following the baseline tests, the engine was put on a 21-hour duty schedule as described in section V(D) and shown in figure 4. A 9-mode test cycle was run at approximately 125-hour intervals throughout a 1,050 hour accumulation period. The complete cycle test results for exhaust sampled upstream of the catalysts are given in appendix D. Similar results for the tests which involved exhaust being sampled downstream of the catalysts are presented in appendix E.

The 9-mode composite values are shown in figures 10 through 13.

Both CO and HC emissions (figures 10 and 11) showed an increasing trend with increased operating time. There was considerable variability in emission levels, both before and after the catalysts. The catalyst conversion efficiency for both CO and HC remained in the 60 to 90 pct range throughout the accumulation period. Oxides of nitrogen emission (figure 12) was in the 5 to 8 g/bhp-hr range throughout the accumulation with no apparent trend with increased operating time. Specific fuel consumption (figure 13) appeared to have a downward trend for the first 400 hours and remained relatively constant with increased operating time beyond 400 hours.

The catalytic converters were inspected periodically for catalyst volume loss during the accumulation of hours. The results were as follows:

Catalyst hours	Catalyst loss, volume percent	
	Left converter	Right converter
0	0	0
300	2	2
600	6	17
945	44	40

The catalyst loss with increased operating time was significant, however, the CO and HC conversion efficiences were still in the 60 to 80 pct range even at the end of 1,050 hours. This high conversion efficiency is attributed to the relatively high catalyst volume per volume of engine displacement. At the start of the program, the ratio of catalyst volume to engine displacement was 1.04 and even after a loss of 44 pct of the catalyst, there was still approximately 0.6 cubic inches of catalyst per cubic inch of engine displacement.

Since the 9-mode cycle emissions were erratic and idle CO was not in specification, additional work was done to attempt to isolate the causes of the increased emissions and erratic behavior.

Tests were made to determine the cylinder-to-cylinder air-fuel ratio (A/F) and EGR distributions at the end of the 1,050 hour accumulation. The A/F and EGR distributions were also determined after cleaning the carburetor, and again after cleaning the intake manifold.

The A/F distribution was determined by analyzing exhaust from individual cylinders and subsequently calculating an A/F for each cylinder. In order to determine EGR distribution, a sampling probe was installed in the intake manifold at the inlet to each cylinder. The inlet mixture to each cylinder was analyzed for CO_2; in addition, CO_2 measurements were made for the exhaust and the intake air. These data allowed the calculation of an EGR rate for each engine cylinder.

The engine cylinders were divided into two groups that were fed by the left and right barrels of the carburetor, respectively. The data are expressed in terms of these two groups of cylinders.

The results of these distribution tests are given in tables 8 and 9. The air-fuel ratio distribution (table 8) was improved by cleaning the carburetor, particularly at idle and light load. Before the carburetor was cleaned, it was fouled to the extent that the idle mixture could not be leaned on the right barrel to reduce CO at idle. The carburetor was completely disassembled and cleaned in a commercial carburetor cleaning solvent. After reassembly and installation on the engine, the carburetor could be adjusted so that idle CO was within specification without any difficulty. The air-fuel ratio distribution was still not perfect, but was within acceptable limits. The intake manifold was then cleaned and further tests were made. The cleaning of the intake manifold did not affect air-fuel ratio distribution (table 8).

The EGR distribution (table 9) was not significantly affected by cleaning the carburetor, but was significantly improved by cleaning of the intake manifold. Visual inspection of the manifold before cleaning revealed a noticeable difference in the amount of deposits in the

TABLE 8. - Air-fuel ratio distribution for the gasoline engine

Mode	Carburetor barrel	Air-fuel ratio		
		Carburetor and intake manifold "as is" following 1,050 hrs of engine operation	Carburetor cleaned but intake manifold "as is" following 1,050 hrs of engine operation	Carburetor and intake manifold cleaned following 1,050 hrs of engine operation
2,000 rpm & 90 pct power	Left	15.6	14.5	14.6
	Right	16.2	15.2	15.5
2,000 rpm & 60 pct power	Left	15.5	14.6	15.0
	Right	15.4	15.2	15.6
2,000 rpm & 30 pct power	Left	17.2	15.4	15.4
	Right	16.6	16.2	16.0
2,000 rpm & 10 pct power	Left	17.6	15.8	15.8
	Right	15.7	16.9	16.0
700 rpm Idle	Left	14.6	15.2	15.7
	Right	12.1	14.4	14.7

TABLE 9. - Exhaust gas recirculation distribution for the gasoline engine

Mode	Carburetor barrel	EGR, pct of intake charge		
		Carburetor and intake manifold "as is" following 1,050 hrs of engine operation	Carburetor cleaned but intake manifold "as is" following 1,050 hrs of engine operation	Carburetor and intake manifold cleaned following 1,050 hrs of engine operation
2,000 rpm & 90 pct power	Left	1.88	2.45	1.79
	Right	1.51	1.82	2.04
2,000 rpm & 60 pct power	Left	9.30	9.54	8.72
	Right	6.22	6.42	8.78
2,000 rpm & 30 pct power	Left	13.4	12.4	11.6
	Right	10.1	8.90	11.1
2,000 rpm & 10 pct power	Left	12.1	13.1	11.5
	Right	8.67	9.50	10.7
700 rpm Idle	Left	1.51	1.26	1.17
	Right	2.08	1.57	1.51

NOTE.-Exhaust gas recirculation values are expressed in terms of percent of intake charge (e.g., 10 pct EGR means that 10 pct of the intake charge is exhaust gas).

EGR feed passages in the intake manifold which caused less exhaust gas to be recirculated to the right side of the manifold and an excess amount to be recirculated to the left side. This effect was confirmed by the EGR distribution measurements (table 9).

The high rate of EGR to the left side is probably responsible for the erratic HC emissions because of misfiring of the cylinders where the EGR rate was highest. The fouled carburetor appeared to be responsible for the erratic CO emission.

After cleaning the carburetor and intake manifold, two replicate 9-mode cycles were run before and after the catalysts. Results from these tests are given in tables D-11, D-12, E-10, and E-11. The average of these two replicate tests are represented by the last data points on figures 10 through 13. Comparing results of the last tests with the results from the previous tests (before cleaning carburetor and intake manifold) indicates that CO was reduced about 20 pct and HC was reduced by about 50 pct by cleaning the carburetor and intake manifold.

The cause for carburetor fouling is unknown, but possibly could have been prevented by using a good fuel additive. The intake manifold fouling was caused by deposits from recirculated exhaust. A change in the EGR system design would probably be required to eliminate the problem.

3. Results of Oil Analysis

A premium SAE 30 oil was used in the gasoline engine throughout the test program. Oil samples were collected at each oil drain which were taken at about 125-hour intervals. The oil samples were analyzed for wear metals by atomic absorption, viscosity (ASTM D445), and pentane and benzene insolubles (ASTM 893). Results are shown in tables 10 through 12.

The results are considered normal and do not indicate any unusual wear conditions. The variation in lead concentration is probably due to variation in lead in the fuel.

TABLE 10. - Elemental analysis of an SAE 30 oil used in the gasoline engine

	Engine hours	Oil hours	Analysis by Bureau of Mines (Atomic absorption)							Analysis by engine manufacturer (X-ray spectroscopy)						
			Element, ppm by weight							Element, ppm by weight						
			Fe	Cr	Al	Mo	Pb	Si	Cu	Fe	Cr	Al*	Mo*	Pb	Si*	Cu
New oil..	-	-	4	0	0	0	0	6	1	<10	<5	-	-	<10	-	2
Used oil.	212	147	45	2	10	0	60	10	4	43	<5	-	-	48	-	30
	364	152	47	3	7	0	330	4	27	39	<5	-	-	>100	-	21
	500	136	24	2	3	1	420	6	18	27	<5	-	-	>100	-	16
	624	124	16	1	3	0	522	3	10	19	<5	-	-	>100	-	10
	737	113	41	1	5	0	1,300	6	11	27	<5	-	-	>100	-	14
	856	119	26	2	6	0	908	3	14	24	<5	-	-	>100	-	14
	986	112	31	3	3	0	829	3	15	31	<5	-	-	>100	-	15
	1,054	68	39	2	9	0	874	3	24	34	<5	-	-	>100	-	19

* These elements were not determined.

TABLE 11. - Pentane and benzene insolubles for an SAE 30 oil used in the gasoline engine

	Engine hours	Oil hours	Analysis by Bureau of Mines (ASTM D893)		Analysis by engine manufacturer (ASTM D893)	
			Pentane insolubles, weight pct	Benzene insolubles, weight pct	Pentane insolubles, volume pct	Benzene insolubles, volume pct
New oil..	-	-	0	0	0	0
Used oil.	212	147	0.04	0.03	0.50	0.25
	364	152	.04	.04	1.50	.50
	500	136	.06	.03	1.00	.25
	624	124	.03	.03	1.00	.50
	737	113	.08	.04	1.00	.50
	856	119	.04	.04	1.00	1.00
	986	112	.06	.04	1.00	1.00
	1,054	68	.06	.06	.50	.50

TABLE 12. - Viscosity of used oil from the gasoline engine (SAE 30 oil)

	Engine hours	Oil hours	Analysis by Bureau of Mines (ASTM D445) Kinetic viscosity, cs		Analysis by engine manufacturer Kinetic viscosity, cs
			100° F	210° F	210° F
New oil...	-	-	111.1	12.15	12.17
Used oil..	212	147	140.0	13.59	13.81
	364	152	153.2	14.30	14.62
	500	136	139.3	13.49	13.69
	624	124	125.3	12.80	12.97
	737	113	141.6	13.58	13.81
	856	119	139.7	13.54	13.78
	986	112	145.4	13.90	14.08
	1,054	68	132.7	13.10	13.40

REFERENCES

1. Environmental Protection Agency. New Motor Vehicles and New Motor Vehicle Engines. 37FR 221, Part II, November 15, 1972, pp. 24,287-24,312.

2. Characterization and Control of Emissions from Heavy Duty Diesel and Gasoline Fueled Engines. Final report prepared for Characterization and Control Branch, Division of Emission Control Technology, Mobile Source Pollution Control Program, Environmental Protection Agency by the Fuels Combustion Research Group, Bartlesville Energy Research Center, Bureau of Mines, under Interagency agreement No. EPA-IAG-0129(D).

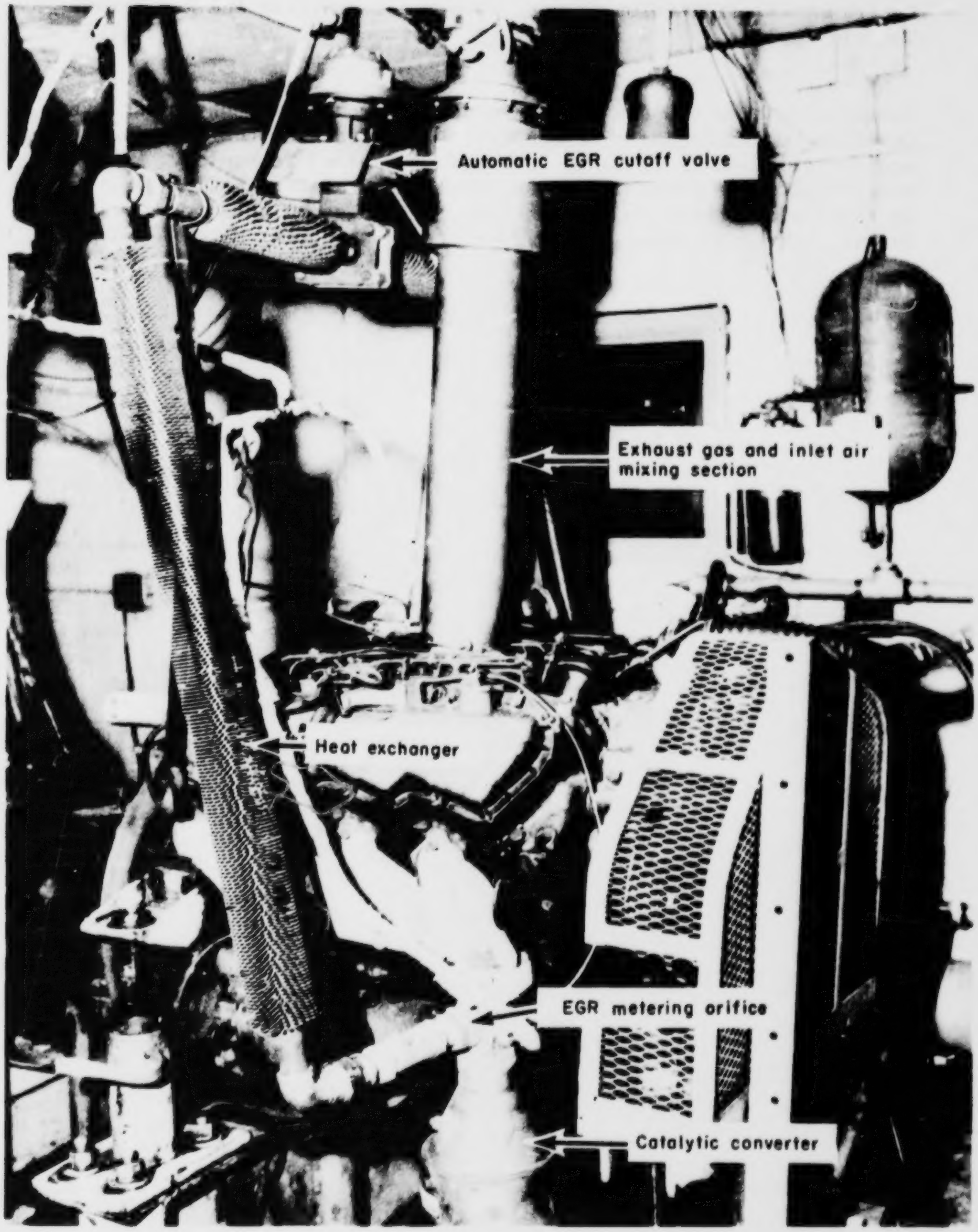

Automatic EGR cutoff valve
Exhaust gas and inlet air mixing section
Heat exchanger
EGR metering orifice
Catalytic converter

FIGURE 1. - Emission Control System Used on the Diesel Engine

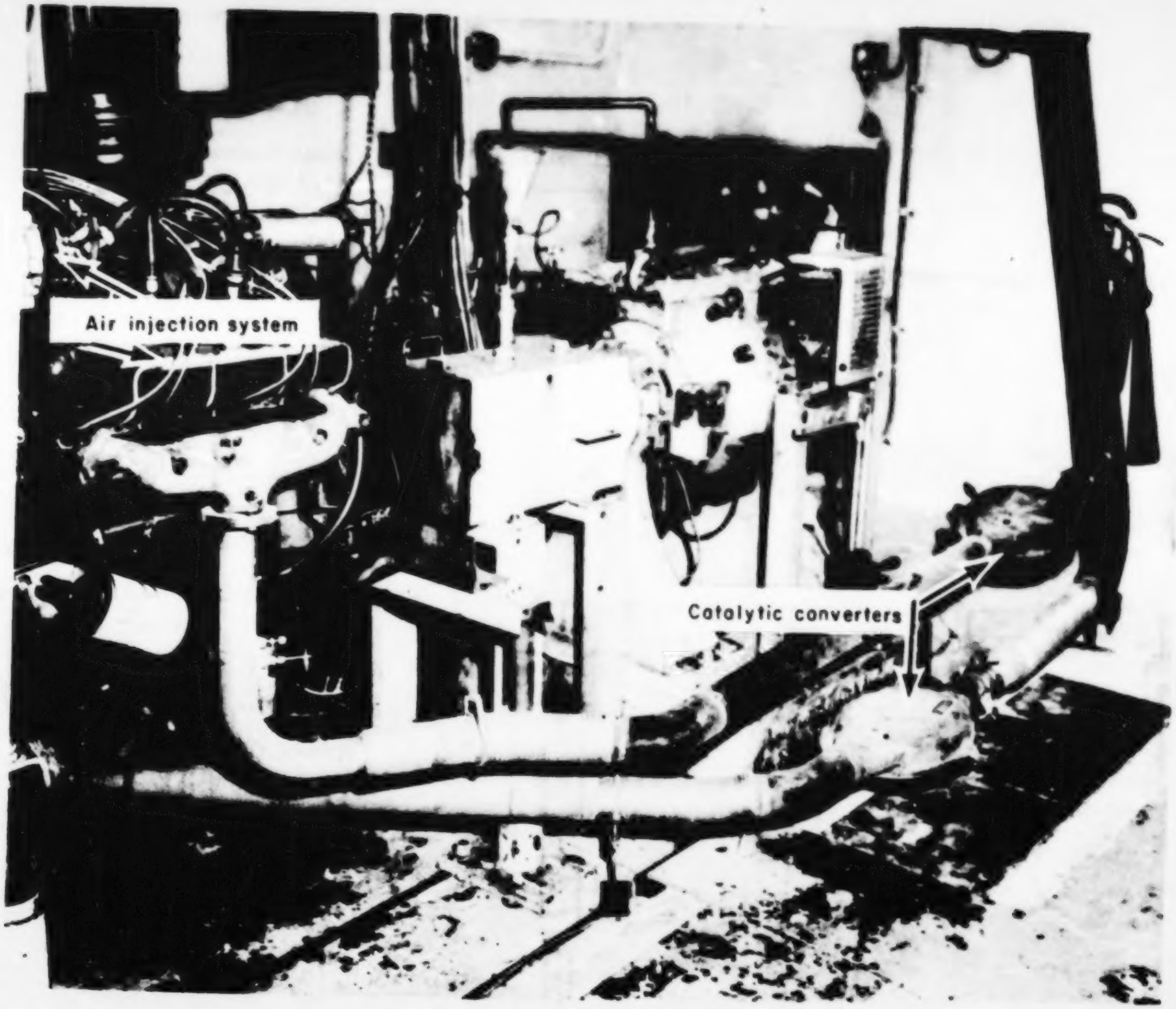
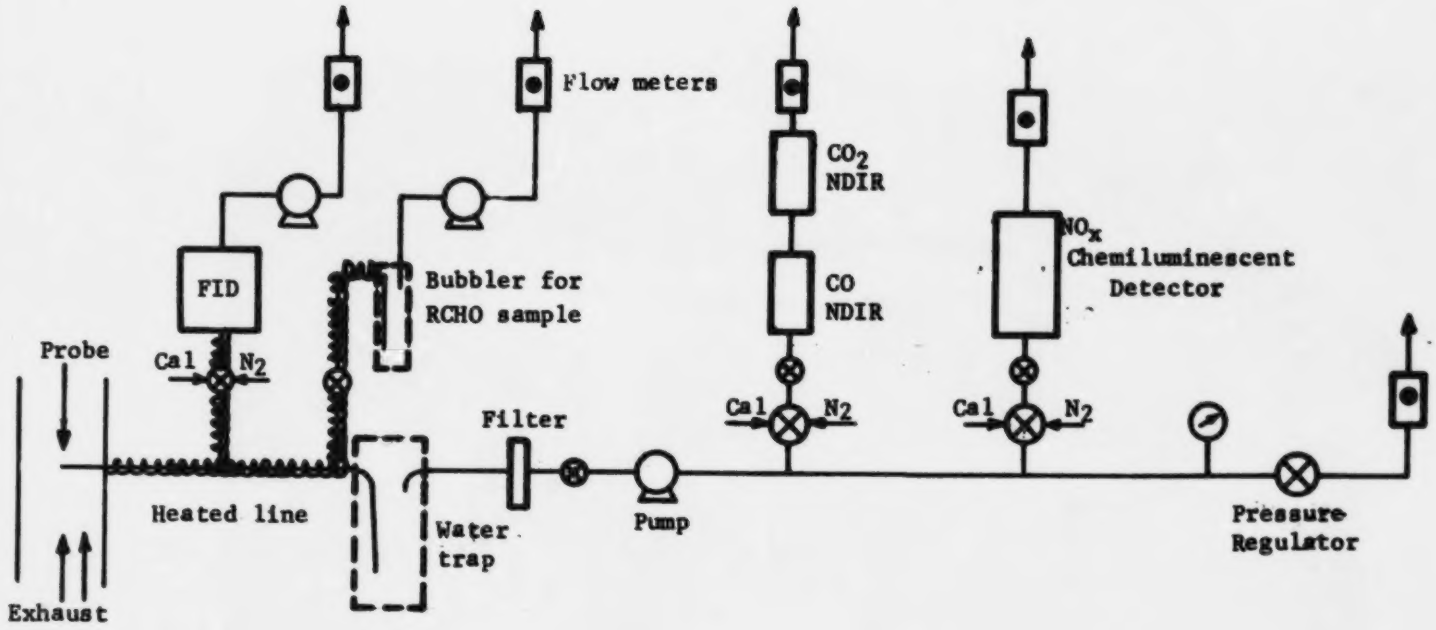

Air injection system
Catalytic converters

FIGURE 2. - Emission Control System Used on the Gasoline Engine


Flow meters
FID
Bubbler for
RCHO sample
Probe
Cal
N_2
Heated line
Exhaust
Water
trap
Filter
Pump
CO_2
NDIR
CO
NDIR
Cal
N_2
NO_x
Chemiluminescent
Detector
Cal
N_2
Pressure
Regulator

1. Water trap maintained at 32° F
2. Sample line:
    a. Heated portion - Stainless steel at 350°F -- total length of stainless steel ≈ 20 feet
    b. Unheated portion - Teflon
3. Probe: 1/4" O.D. stainless steel
4. Total sample flow ≈ 30 cfh
5. FID - heated (oven temperature ≈ 350°F), vacuum type

FIGURE 3. - Schematic of Exhaust Sampling and Analytical System Used in Diesel and Gasoline Engine Tests

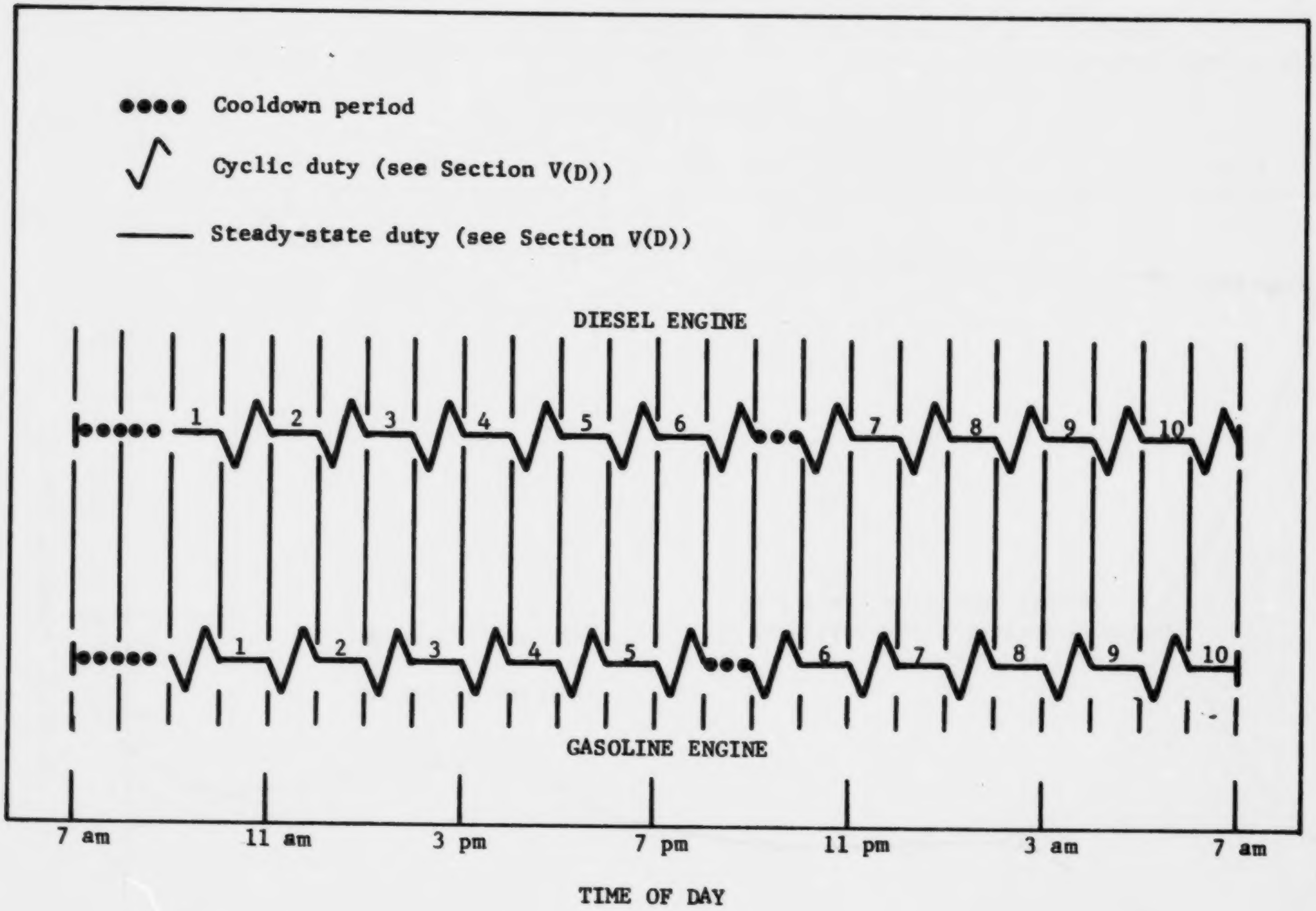


FIGURE 4. - Daily Accumulation Cycle for Diesel and Gasoline Engines

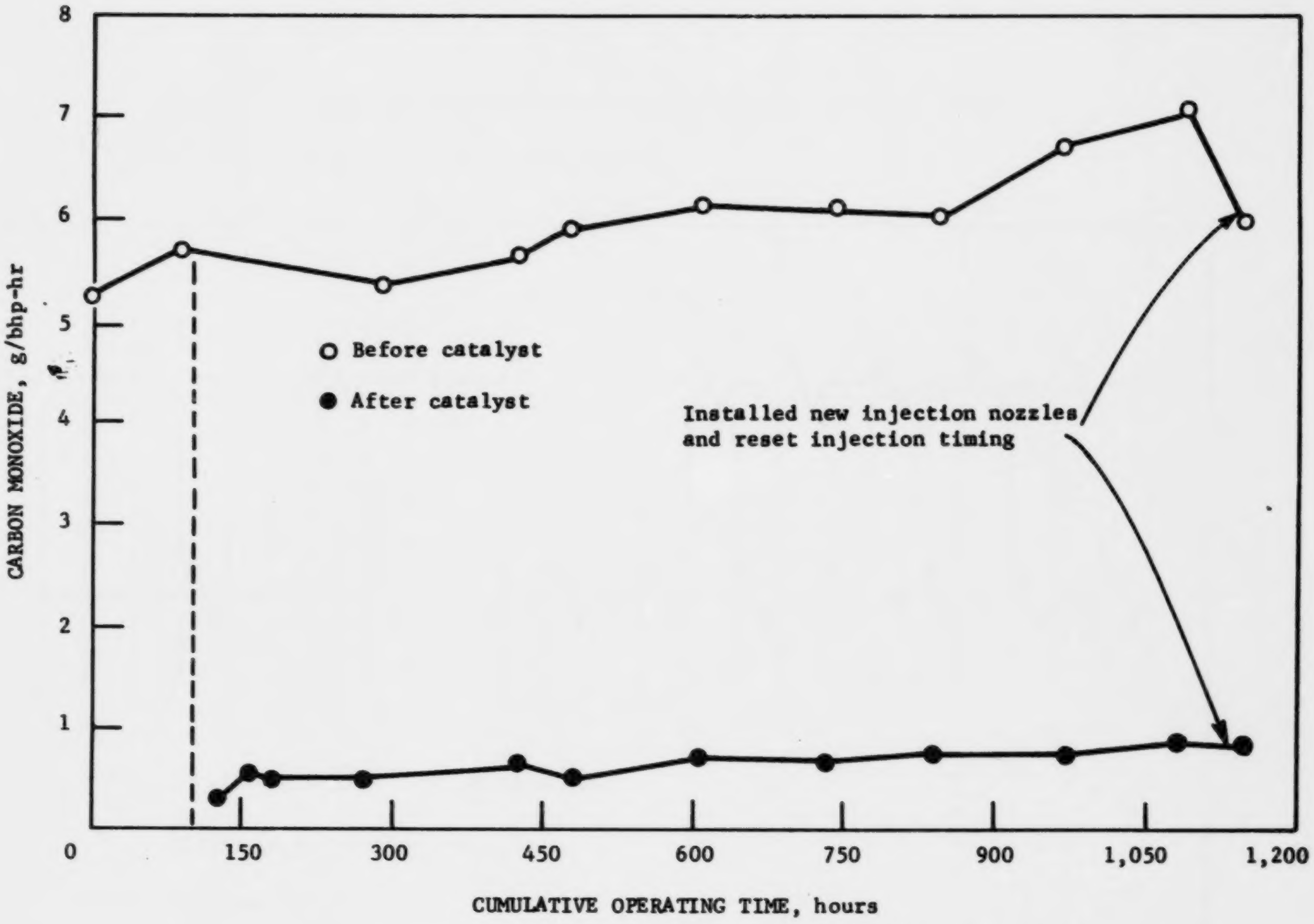


FIGURE 5. - The Influence of Operating Time on Carbon Monoxide Emission (Diesel Engine with Injection Timing Retarded 3°, Two Platinum Monolithic Catalysts, and 10 Pct EGR)

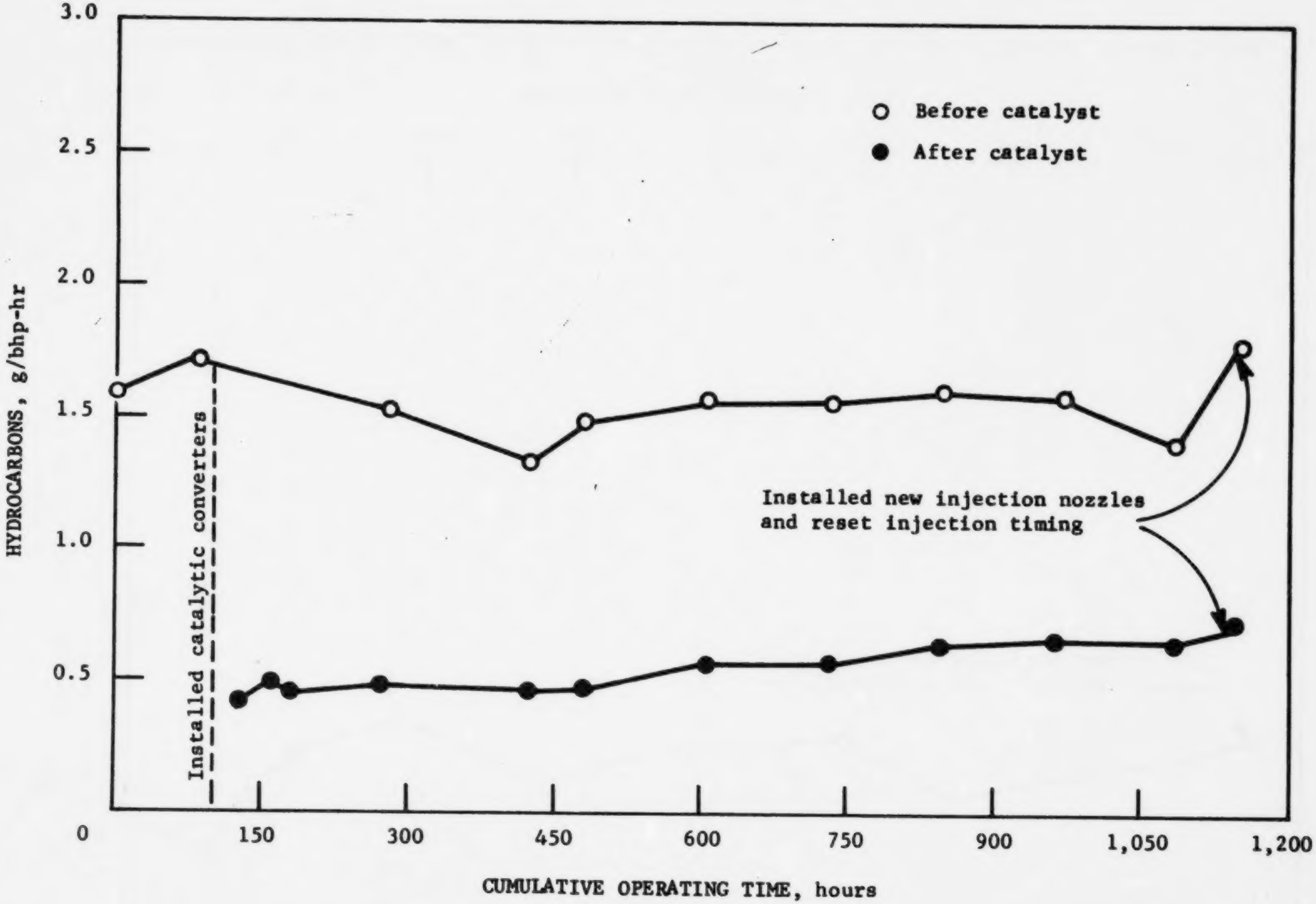


FIGURE 6. - The Influence of Operating Time on Hydrocarbon Emission (Diesel Engine with Injection Timing Retarded 3°, Two Platinum Monolithic Catalysts, and 10 Pct EGR)

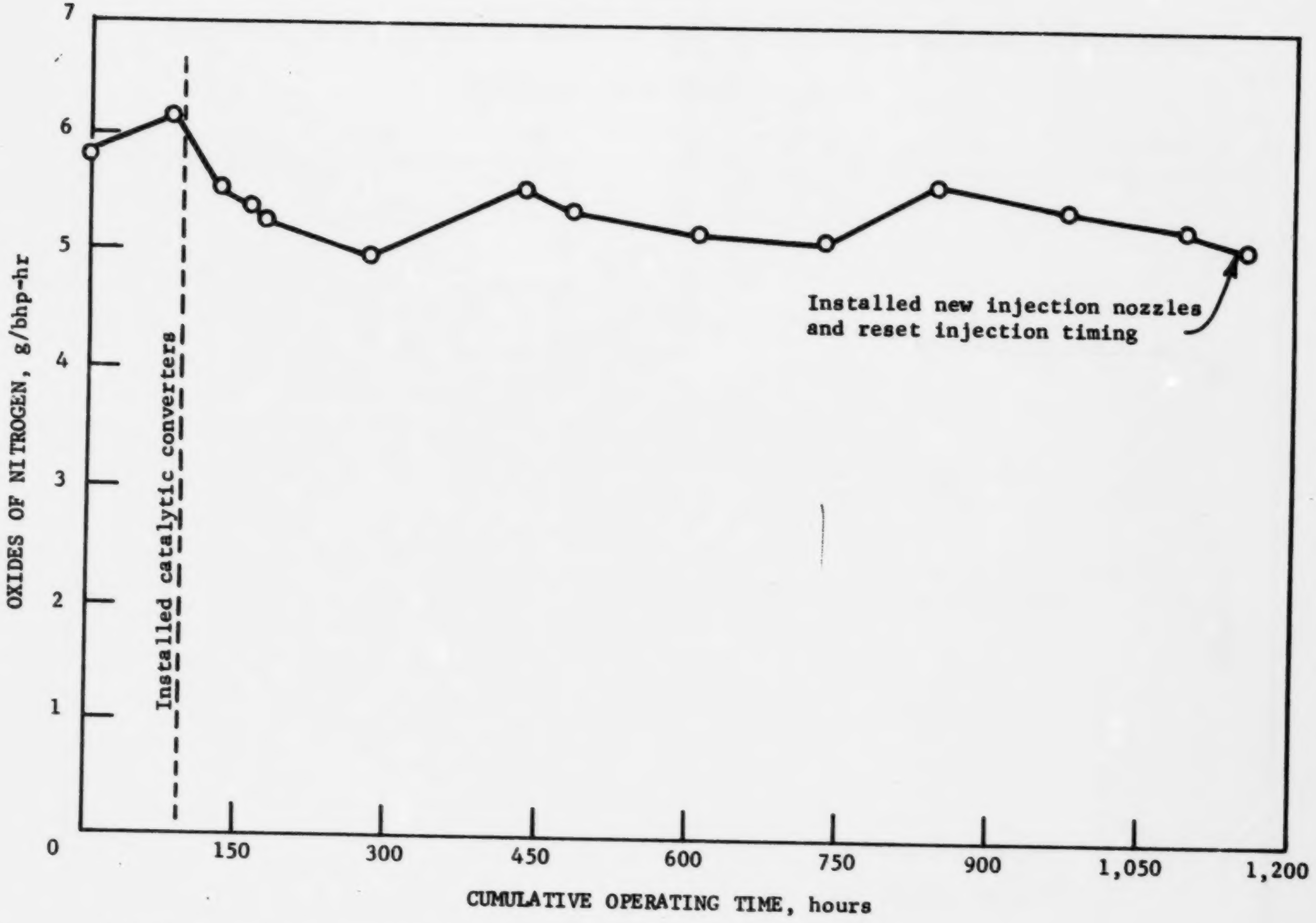


FIGURE 7. - The Influence of Operating Time on Oxides of Nitrogen Emission (Diesel Engine with Injection Timing Retarded 3°, Two Platinum Monolithic Catalysts, and 10 Pct EGR)

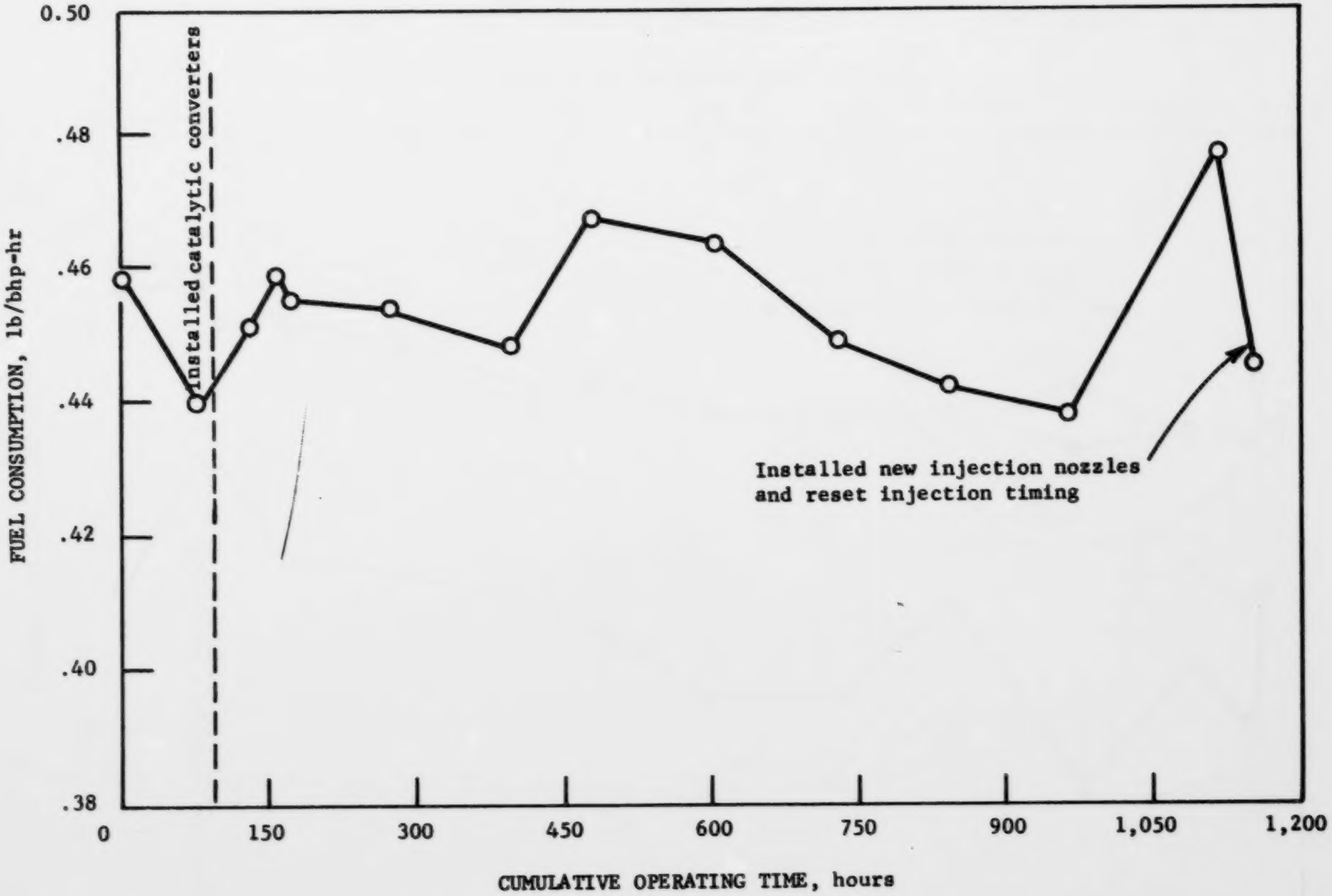


FIGURE 8. - The Influence of Operating Time on Specific Fuel Consumption (Diesel Engine with Injection Timing Retarded 3°, Two Platinum Monolithic Catalysts, and 10 Pct EGR)

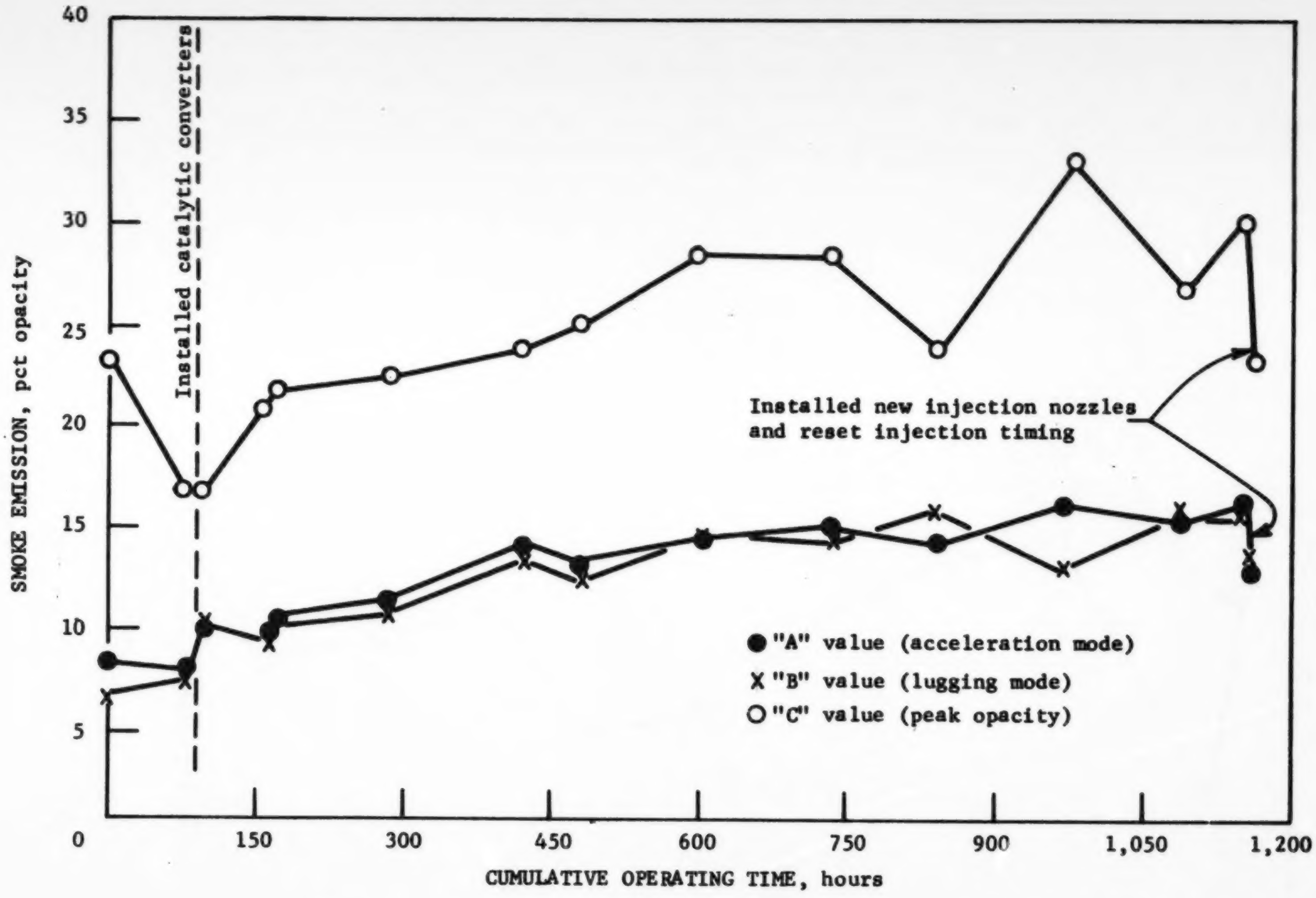


FIGURE 9. - The Influence of Operating Time on Smoke (Diesel Engine with Injection Timing Retarded 3°, Two Platinum Monolithic Catalysts, and 10 Pct EGR)

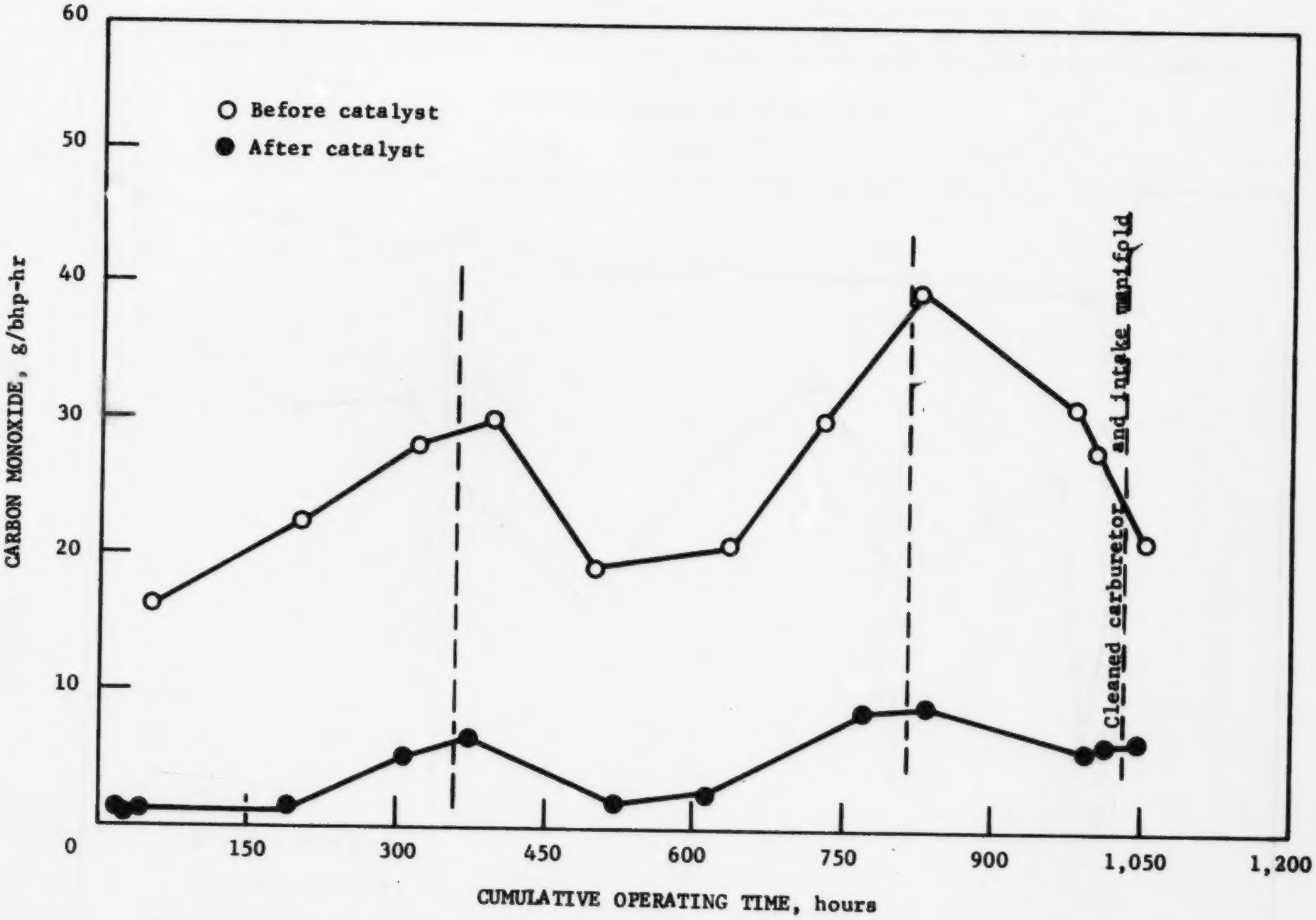


FIGURE 10. - The Influence of Operating Time on Carbon Monoxide Emission (Gasoline Engine with Standard Ignition Timing, Manifold Air Injection, Two Platinum Pelleted Oxidation Catalysts, and 10 Pct EGR)

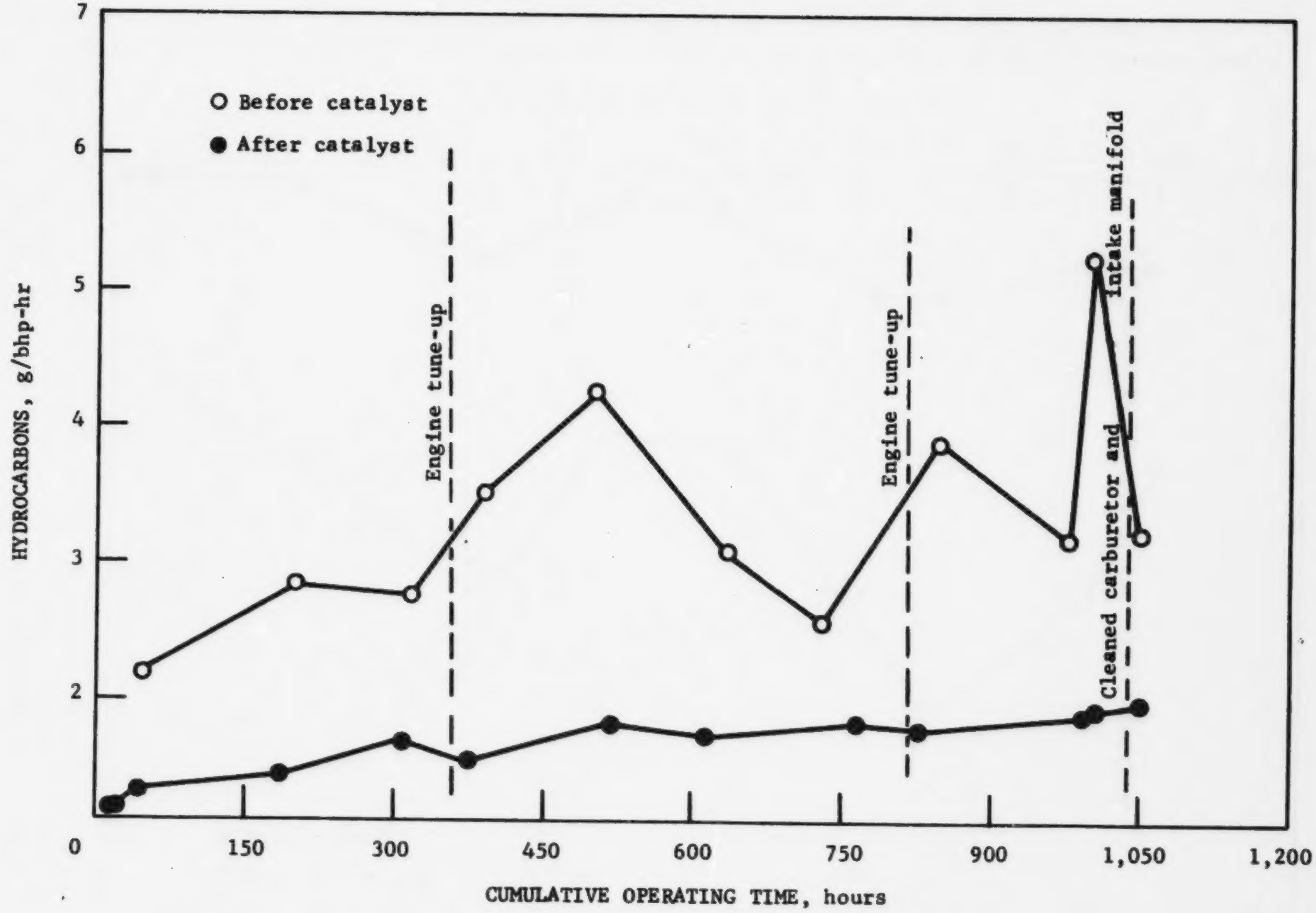


FIGURE 11. - The Influence of Operating Time on Hydrocarbon Emission (Gasoline Engine with Standard Ignition Timing, Manifold Air Injection, Two Platinum Pelleted Oxidation Catalysts, and 10 Pct EGR)

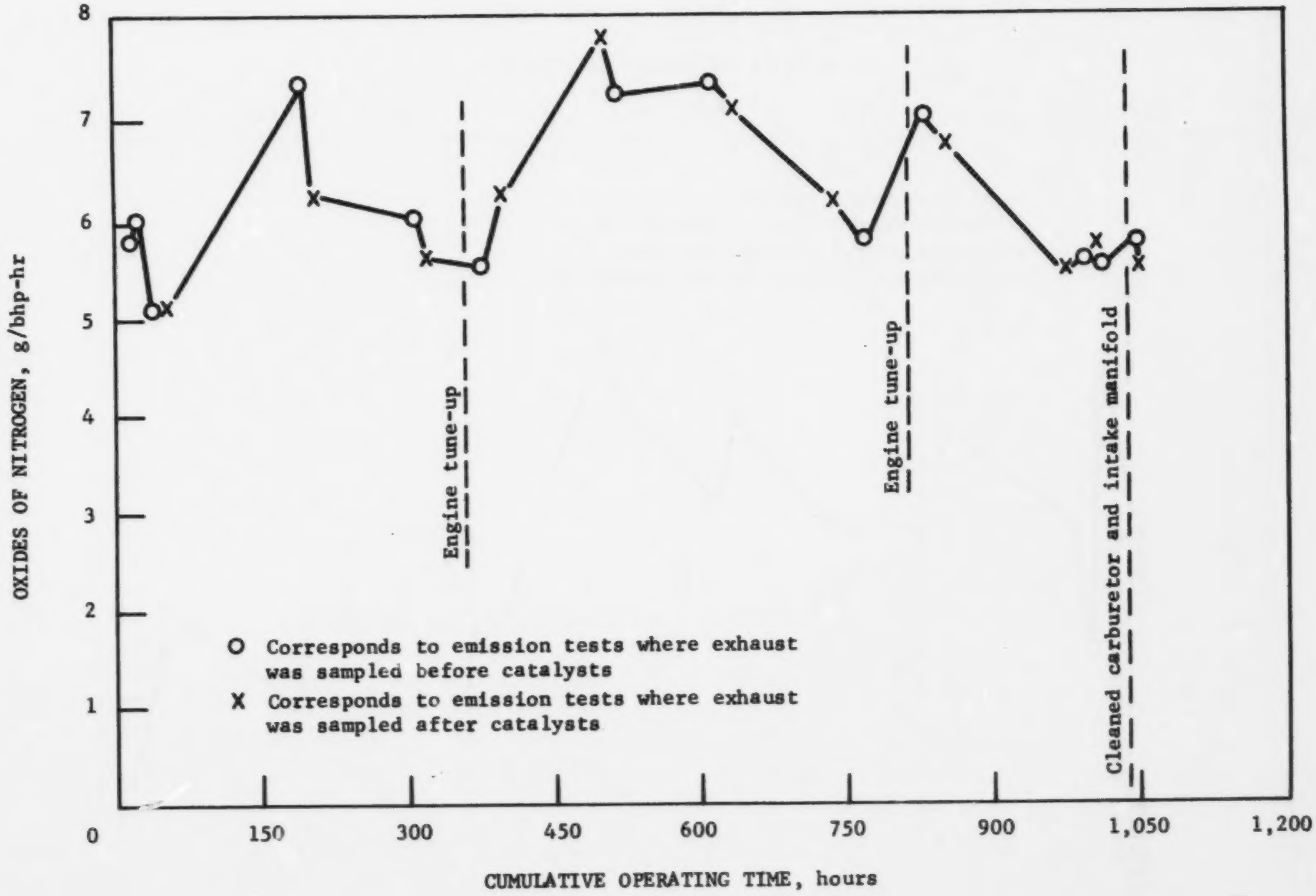


FIGURE 12. - The Influence of Operating Time on Oxides of Nitrogen Emission (Gasoline Engine with Standard Ignition Timing, Manifold Air Injection, Two Platinum Pelleted Oxidation Catalysts, and 10 Pct EGR)

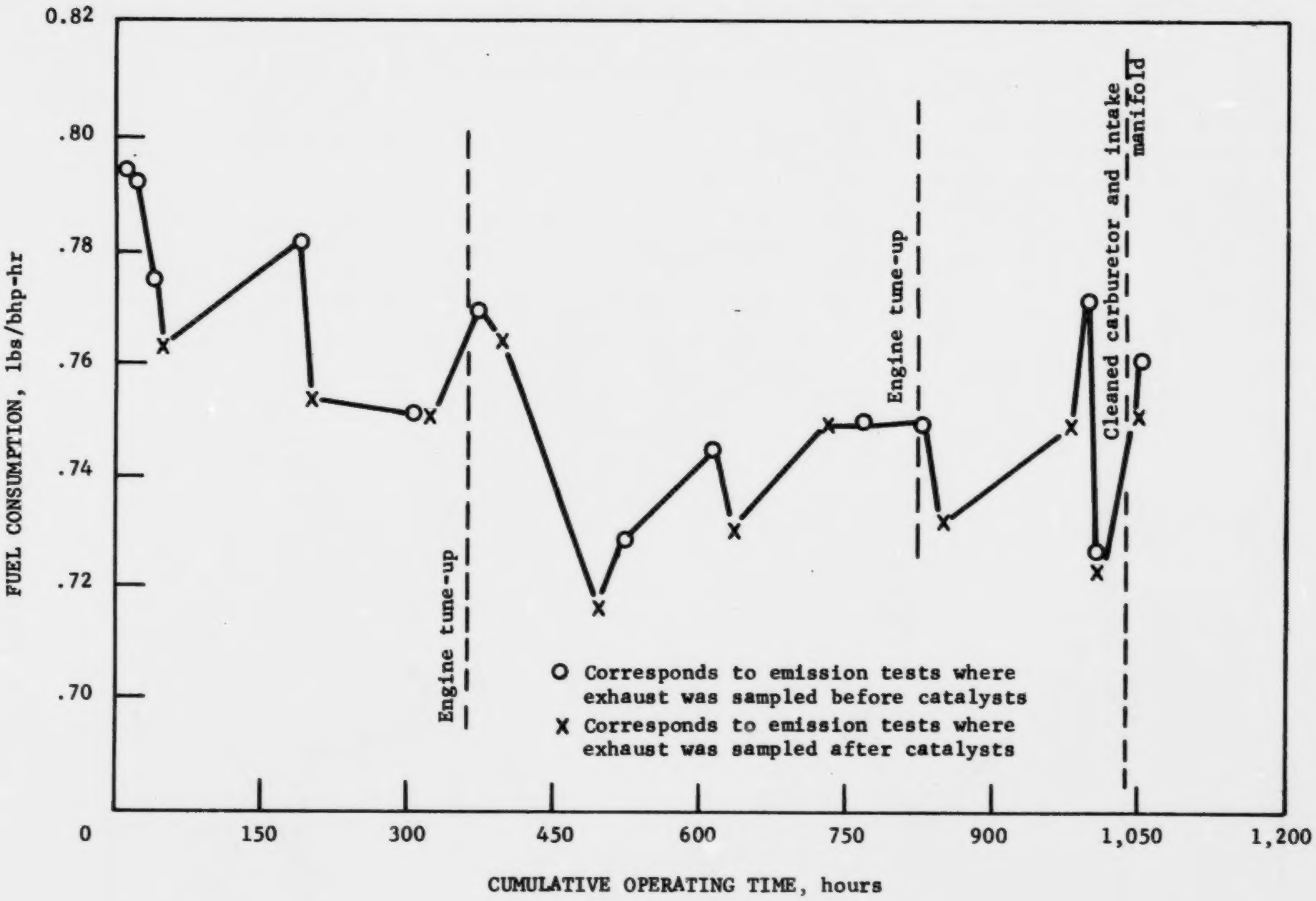


FIGURE 13. - The Influence of Operating Time on Specific Fuel Consumption (Gasoline Engine with Standard Ignition Timing, Manifold Air Injection, Two Platinum Pelleted Oxidation Catalysts, and 10 Pct EGR)

APPENDIX A.--BASELINE EMISSION DATA FOR THE DIESEL ENGINE

TABLE A-1. - Baseline gaseous emissions for diesel engine adjusted to manufacturer's specifications

[Test No. 1--engine hours = 27]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	575	0	427	2.4	380	563	154	71.2	52.8	47.3
2	1,680	2.9	1,123	8.7	720	771	138	354.7	190.2	111.6
3	1,680	11.5	1,152	11.5	711	673	207	359.3	170.3	171.7
4	1,680	25.6	1,129	15.1	650	575	355	321.9	142.6	288.6
5	1,680	35.5	1,132	17.6	547	538	463	271.6	133.8	377.4
6	1,680	71.0	1,142	28.0	299	428	968	149.8	107.4	795.9
7	1,680	106.5	1,100	38.6	141	300	1,472	68.0	72.5	1165.8
8	1,680	116.4	1,102	41.1	173	392	1,595	83.6	94.9	1265.5
9	1,680	130.5	1,108	47.5	299	404	1,660	145.3	98.3	1324.3
10	1,680	142.0	1,114	53.2	1,256	233	1,589	613.7	57.0	1274.5
11	575	0	427	2.5	344	485	164	64.4	45.5	50.4
12	-	-	-	-	-	-	-	-	-	-
13	2,800	199.4	1,670	81.6	1,644	140	1,406	1204.2	51.4	1690.6
14	2,800	183.4	1,691	73.5	776	172	1,368	575.6	63.9	1665.6
15	2,800	163.7	1,684	65.6	478	191	1,231	353.1	70.6	1492.6
16	2,800	149.3	1,679	60.9	374	204	1,129	275.4	75.2	1364.8
17	2,800	99.7	1,663	45.1	333	523	787	242.9	191.0	942.3
18	2,800	50.1	1,649	30.9	688	587	433	497.6	212.6	514.1
19	2,800	35.7	1,646	27.6	847	689	320	611.5	249.1	379.2
20	2,800	16.0	1,640	22.5	1,035	937	198	744.5	337.5	233.8
21	2,800	3.7	1,638	20.1	1,080	1,128	149	776.0	405.8	175.7
22	575	0	267	1.8	324	453	196	37.9	26.6	37.7
23	-	-	-	-	-	-	-	-	-	-

==Composite Cycle Emissions==

==13-Mode cycle==

BSCO	5.35 g/bhp-hr
BSHC	1.86 g/bhp-hr
$BSNO_2$	9.91 g/bhp-hr
BSFC	0.454 lb/bhp-hr

==23-Mode cycle==

BSCO	4.72 g/bhp-hr
BSHC	1.82 g/bhp-hr
$BSNO_2$	9.97 g/bhp-hr
BSFC	0.455 lb/bhp-hr

==Test Conditions==

Barometer 736.2 mmHg
Humidity 53 grains H_2O/lb dry air
Max. inlet restriction 24" H_2O
Max. exhaust backpressure 33" H_2O
Inlet air temperature 74° F
Max. exhaust temperature 1,200° F

* NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE A-1. - Baseline gaseous emissions for diesel engine adjusted to manufacturer's specifications-Continued

[Test No. 2--engine hours = 29]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	575	0	398	2.1	386	513	160	67.3	44.9	45.8
2	1,680	2.9	1,143	8.8	752	750	133	376.7	188.6	109.5
3	1,680	11.5	1,092	11.1	707	651	216	338.4	156.4	169.8
4	1,680	25.6	1,123	15.2	659	540	386	324.4	133.4	312.1
5	1,680	35.5	1,125	17.7	542	500	482	267.3	123.8	390.4
6	1,680	71.0	1,081	26.1	257	421	933	121.8	100.1	726.2
7	1,680	106.5	1,148	40.2	158	290	1,532	79.5	73.2	1266.3
8	1,680	116.4	1,097	42.5	202	421	1,596	97.1	101.6	1260.6
9	1,680	130.5	1,102	47.0	373	415	1,646	180.2	100.6	1306.0
10	1,680	142.0	1,108	53.1	1,295	243	1,560	628.9	59.2	1244.5
11	575	0	424	2.4	372	447	154	69.1	41.7	47.0
12	-	-	-	-	-	-	-	-	-	-
13	2,800	199.4	1,689	80.5	1,667	132	1,356	1234.1	49.0	1649.0
14	2,800	183.4	1,683	73.8	831	191	1,325	613.0	70.7	1605.6
15	2,800	163.7	1,675	65.8	500	197	1,197	367.1	72.6	1443.6
16	2,800	149.3	1,669	60.7	423	211	1,084	309.4	77.5	1302.6
17	2,800	99.7	1,654	45.0	363	573	732	263.2	208.5	871.7
18	2,800	50.1	1,640	31.0	708	566	428	508.9	204.2	505.4
19	2,800	35.7	1,636	27.2	898	658	300	643.9	236.8	353.4
20	2,800	16.0	1,631	22.5	1,077	875	189	769.9	314.0	221.9
21	2,800	3.7	1,629	20.3	1,102	1,165	141	786.8	417.5	165.4
22	575	0	398	2.3	380	513	145	66.3	44.9	41.6
23	-	-	-	-	-	-	-	-	-	-

==Composite Cycle Emissions==

==13-Mode cycle==

BSCO	5.52 g/bhp-hr
BSHC	1.87 g/bhp-hr
$BSNO_2$	9.70 g/bhp-hr
BSFC	0.454 lb/bhp-hr

==23-Mode cycle==

BSCO	4.92 g/bhp-hr
BSHC	1.81 g/bhp-hr
$BSNO_2$	9.59 g/bhp-hr
BSFC	0.453 lb/bhp-hr

==Test Conditions==

Barometer 734.5 mmHg
Humidity 57 grains H_2O/lb dry air
Max. inlet restriction 24" H_2O
Max. exhaust backpressure 34" H_2O
Inlet air temperature 75° F
Max. exhaust temperature 1,220° F

* NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE A-1. - **Baseline gaseous emissions for diesel engine adjusted to manufacturer's specifications-Continued**

[Test No. 3--engine hours = 31]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	575	0	424	2.5	409	508	147	76.0	47.4	44.9
2	1,680	2.9	1,090	8.8	763	742	128	364.5	177.9	100.5
3	1,680	11.5	1,118	11.2	755	645	201	370.0	158.6	161.8
4	1,680	25.6	1,122	15.2	660	540	348	324.6	133.3	281.1
5	1,680	35.5	1,125	17.4	567	495	449	279.6	122.5	363.7
6	1,680	71.0	1,135	27.8	256	436	941	127.4	108.9	769.0
7	1,680	106.5	1,146	38.3	158	280	1,444	79.4	70.6	1191.5
8	1,680	116.4	1,097	42.5	210	469	1,535	101.0	113.2	1212.4
9	1,680	130.5	1,102	47.3	347	397	1,618	167.6	96.2	1283.8
10	1,680	142.0	1,106	51.8	999	267	1,572	484.3	65.0	1251.8
11	575	0	424	2.5	385	417	149	71.5	38.9	45.5
12	-	-	-	-	-	-	-	-	-	-
13	2,800	199.4	1,690	81.5	1,561	161	1,352	1156.3	59.9	1645.1
14	2,800	183.4	1,683	74.6	927	195	1,321	683.8	72.2	1600.7
15	2,800	163.7	1,676	68.1	648	215	1,169	476.0	79.3	1410.7
16	2,800	149.3	1,669	61.1	445	222	1,160	325.5	81.5	1393.9
17	2,800	99.7	1,696	45.1	363	538	748	269.8	200.7	913.4
18	2,800	50.1	1,639	30.9	735	565	409	528.0	203.7	482.7
19	2,800	35.7	1,635	26.5	888	551	295	636.4	198.2	347.3
20	2,800	16.0	1,630	22.3	1,077	888	190	769.4	318.4	223.0
21	2,800	3.7	1,628	20.1	1,084	1,029	145	773.5	368.5	170.0
22	575	0	398	2.2	372	484	151	64.9	42.4	43.3
23	-	-	-	-	-	-	-	-	-	-

==Composite Cycle Emissions==

==13-Mode cycle==

BSCO	5.31 g/bhp-hr
BSHC	1.82 g/bhp-hr
$BSNO_2$	9.76 g/bhp-hr
BSFC	0.452 lb/bhp-hr

==23-Mode cycle==

BSCO	5.10 g/bhp-hr
BSHC	1.78 g/bhp-hr
$BSNO_2$	9.66 g/bhp-hr
BSFC	0.458 lb/bhp-hr

==Test Conditions==

Barometer 734.2 mmHg
Humidity 56 grains H_2O/lb dry air
Max. inlet restriction 24" H_2O
Max. exhaust backpressure 34" H_2O
Inlet air temperature 74° F
Max. exhaust temperature 1,230° F

* NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE A-2. - Baseline gaseous emissions for diesel engine equipped with emission controls (Injection timing retarded 3°, two monolithic platinum oxidation catalysts, and 10 pct EGR)

[Test No. 1--total engine hours = 176; hours with EGR and retarded timing = 127; hours with catalysts = 30]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	575	0	356	2.8	247	322	167	38.5	25.2	42.8
2	1,680	2.9	1,015	8.8	260	679	113	116	152	82.6
3	1,680	11.5	1,017	11.0	237	632	164	106	141	120
4	1,680	26.5	1,021	14.8	35	199	244	15.7	44.7	179
5	1,680	36.8	1,024	17.2	13	92	302	5.83	20.7	223
6	1,680	73.6	1,033	27.0	12	37	422	5.43	8.41	314
7	1,680	110.4	1,017	37.8	25	31	628	11.1	6.94	460
8	1,680	120.6	1,022	42.2	25	34	656	11.2	7.64	483
9	1,680	135.3	1,136	47.8	25	20	1,029	12.4	5.00	842
10	1,680	147.1	1,141	52.5	28	22	1,032	14.0	5.52	781
11	575	0	356	2.8	212	269	179	33.1	21.1	45.9
12	-	-	-	-	-	-	-	-	-	-
13	2,800	199.4	1,712	80.0	32	39	967	24.0	14.7	1,192
14	2,800	183.4	1,708	76.2	33	28	934	24.7	10.5	1,149
15	2,800	163.7	1,538	69.0	24	41	591	16.2	13.9	654
16	2,800	149.3	1,533	64.5	28	44	566	18.8	14.8	625
17	2,800	99.7	1,516	47.0	25	39	471	16.6	13.0	514
18	2,800	50.1	1,501	32.2	17	47	276	11.2	15.5	298
19	2,800	35.7	1,497	28.2	26	67	224	17.1	22.1	241
20	2,800	16.0	1,493	24.0	17	91	153	11.1	29.9	164
21	2,800	3.7	1,490	21.0	17	120	118	11.1	39.3	127
22	575	0	356	2.5	279	314	103	43.5	24.6	26.4
23	-	-	-	-	-	-	-	-	-	-

==Composite Cycle Emissions==

==13-mode cycle==

BSCO	0.38	g/bhp-hr
BSHC	.40	g/bhp-hr
$BSNO_2$	5.40	g/bhp-hr
BSFC	.452	lb/bhp-hr

==23-mode cycle==

BSCO	0.58	g/bhp-hr
BSHC	.61	g/bhp-hr
$BSNO_2$	5.42	g/bhp-hr
BSFC	.464	lb/bhp-hr

==Test Conditions==

Barometer 745 mmHg
Humidity 46 grains H_2O/lb dry air
Maximum inlet restriction 24 inches H_2O
Maximum exhaust back pressure 34 inches H_2O
Inlet air temperature 70° F
Maximum exhaust temperature 1,294° F
EGR rate at 75 pct load and rated speed 9.5 pct

* NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE A-2. - Baseline gaseous emissions for diesel engine equipped with emission controls (Injection timing retarded 3°, two monolithic platinum oxidation catalysts, and 10 pct EGR)-Continued

[Test No. 2--total engine hours = 209; hours with EGR and retarded timing = 160; hours with catalysts = 63]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	575	0	352	2.0	267	353	119	41.2	27.3	30.2
2	1,680	2.9	1,031	8.8	560	647	114	253	147	84.6
3	1,680	11.5	1,033	10.8	553	624	156	250	142	116
4	1,680	26.5	1,010	14.5	104	300	245	46.0	66.7	178
5	1,680	36.8	1,013	17.0	21	133	300	9.32	29.6	219
6	1,680	73.6	1,025	29.0	25	40	434	11.2	9.02	320
7	1,680	110.4	1,009	39.8	28	29	633	12.4	6.44	460
8	1,680	120.6	1,012	42.8	16	29	655	7.10	6.46	477
9	1,680	135.3	1,124	48.0	20	23	1,017	9.85	5.69	823
10	1,680	147.1	1,130	53.5	20	23	1,027	9.91	5.72	836
11	575	0	352	1.8	262	300	99	40.4	23.2	25.1
12	-	-	-	-	-	-	-	-	-	-
13	2,800	191.9	1,695	80.0	36	43	952	26.7	16.0	1,162
14	2,800	176.5	1,689	74.0	33	39	871	24.4	14.5	1,059
15	2,800	157.3	1,547	66.8	33	52	556	22.4	17.7	619
16	2,800	143.9	1,515	62.2	33	52	537	21.9	17.3	586
17	2,800	96.0	1,499	45.5	34	59	428	22.3	19.5	462
18	2,800	48.0	1,483	30.2	26	72	256	16.9	23.5	273
19	2,800	34.6	1,480	27.2	26	85	201	16.9	27.7	214
20	2,800	15.5	1,476	22.8	26	130	140	16.8	42.2	149
21	2,800	3.7	1,474	20.8	26	173	109	16.8	56.1	116
22	575	0	352	2.2	262	394	126	40.4	30.5	31.9
23	-	-	-	-	-	-	-	-	-	-

==Composite Cycle Emissions==

==13-mode cycle==		==23-mode cycle==	
BSCO	0.59 g/bhp-hr	BSCO	1.00 g/bhp-hr
BSHC	.47 g/bhp-hr	BSHC	.69 g/bhp-hr
$BSNO_2$	5.37 g/bhp-hr	$BSNO_2$	5.24 g/bhp-hr
BSFC	.459 lb/bhp-hr	BSFC	.466 lb/bhp-hr

*NO_x data are corrected to 75 grains H_2O/lb humidity.

==Test Conditions==

Barometer 737 mmHg
Humidity 63 grains H_2O/lb dry air
Maximum inlet restriction 24 inches H_2O
Maximum exhaust back pressure 34 inches H_2O
Inlet air temperature 70° F
Maximum exhaust temperature 1,295° F
EGR rate at 75 pct load and rated speed 9.5 pct

TABLE A-2. - Baseline gaseous emissions for diesel engine equipped with emission controls (Injection timing retarded 3°, two monolithic platinum oxidation catalysts, and 10 pct EGR)-Continued

[Test No. 3--total engine hours = 228; hours with EGR and retarded timing = 179; hours with catalysts = 82]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	575	0	351	2.2	321	341	102	49.4	26.3	25.8
2	1,680	2.9	1,028	8.8	605	664	105	273	150	77.7
3	1,680	11.5	1,031	11.2	592	618	154	268	140	114
4	1,680	26.5	1,008	14.8	79	258	238	39.9	57.2	173
5	1,680	36.8	1,010	17.5	17	90	303	7.53	20.0	220
6	1,680	73.6	1,020	26.8	17	26	423	7.60	5.83	311
7	1,680	110.4	1,006	39.8	17	26	604	7.50	5.75	437
8	1,680	120.6	1,011	44.8	16	13	624	7.09	2.89	454
9	1,680	135.3	1,122	48.8	20	19	961	9.84	4.69	776
10	1,680	147.1	1,127	53.8	20	16	973	9.88	3.97	790
11	575	0	351	2.0	276	364	112	42.5	28.1	28.3
12	-	-	-	-	-	-	-	-	-	-
13	2,800	197.3	1,690	80.2	28	39	929	20.7	14.5	1,130
14	2,800	181.3	1,685	75.2	28	26	909	20.7	9.64	1,103
15	2,800	161.5	1,517	68.2	28	39	565	18.6	13.0	617
16	2,800	148.2	1,514	65.0	28	29	555	18.6	9.66	605
17	2,800	98.6	1,495	46.5	25	45	446	16.4	14.8	480
18	2,800	49.6	1,480	31.2	21	64	353	13.6	20.8	376
19	2,800	35.7	1,477	28.0	17	84	307	11.0	27.3	326
20	2,800	16.0	1,473	23.8	17	116	143	11.0	37.6	152
21	2,800	3.7	1,470	21.0	17	151	108	11.0	48.8	114
22	575	0	351	2.2	275	348	108	42.3	26.9	27.3
23	-	-	-	-	-	-	-	-	-	-

==Composite Cycle Emissions==

==13-mode cycle==		==23-mode cycle==	
BSCO	0.57 g/bhp-hr	BSCO	1.00 g/bhp-hr
BSHC	.42 g/bhp-hr	BSHC	.63 g/bhp-hr
$BSNO_2$	5.31 g/bhp-hr	$BSNO_2$	5.30 g/bhp-hr
BSFC	.456 lb/bhp-hr	BSFC	.466 lb/bhp-hr

*NO_x data are corrected to 75 grains H_2O/lb humidity.

==Test Conditions==

Barometer 734.9 mmHg
Humidity 68 grains H_2O/lb dry air
Maximum inlet restriction 24 inches H_2O
Maximum exhaust back pressure 34 inches H_2O
Inlet air temperature 70° F
Maximum exhaust temperature 1,305° F
EGR rate at 75 pct load and rated speed 9.8 pct

APPENDIX B.--EMISSION DATA FROM THE DURABILITY TESTING OF THE DIESEL ENGINE

TABLE B-1. - **Gaseous emissions of diesel engine at 49 engine hours and 0 hours on emission controls (Injection timing retarded 3°, and 10 pct EGR; no catalyst installed)**

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	575	0	381	2.9	306	463	112	51.1	38.8	30.7
2	1,680	2.9	1,034	9.0	636	722	101	288.2	164.2	75.2
3	1,680	36.5	1,044	18.1	579	491	287	264.9	112.8	215.7
4	1,680	72.6	1,053	27.6	286	353	590	132.0	81.8	447.3
5	1,680	109.1	1,066	40.2	190	287	780	88.8	67.3	598.7
6	1,680	145.2	1,134	54.1	572	165	1,193	284.3	41.2	974.1
7	575	0	406	3.0	310	498	115	55.2	44.5	33.6
8	2,800	202.6	1,723	82.1	1,521	114	988	1,148.6	43.2	1,225.7
9	2,800	151.9	1,542	63.3	1,154	252	574	779.9	85.5	637.3
10	2,800	101.3	1,526	46.9	569	558	462	380.6	187.3	507.6
11	2,800	50.6	1,512	32.4	755	612	276	500.3	203.6	300.5
12	2,800	4.3	1,474	21.5	1,012	1,116	116	653.8	361.9	123.1
13	575	0	379	2.8	348	552	104	57.8	46.0	28.4

==Composite Cycle Emissions, 13-mode cycle==

BSCO	5.31	g/bhp-hr
BSHC	1.66	g/bhp-hr
$BSNO_2$	5.91	g/bhp-hr
BSFC	.459	lb/bhp-hr

==Test Conditions==

Barometer 744 mmHg
Humidity 45.1 grains H_2O/lb dry air
Maximum inlet restriction 24 inches H_2O
Maximum exhaust back pressure 34 inches H_2O
Inlet air temperature 72° F
Maximum exhaust temperature 1,291° F
EGR rate at 75 pct load and rated speed 10 pct**

*NO_x data are corrected to 75 grains H_2O/lb humidity.

**NOTE.-EGR rate was not measured during this test; the 10 pct EGR is a nominal value.

TABLE B-2. - Gaseous emissions of diesel engine at 128 engine hours and 79 hours on emission controls (Injection timing retarded 3°, and 10 pct EGR; no catalyst installed)

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	700	0	405	3.4	301	517	111	53.4	46.1	32.4
2	1,680	2.9	1,001	9.2	609	844	108	267	186	77.8
3	1,680	35.8	1,035	17.3	555	535	323	252	122	241
4	1,680	71.7	1,045	26.8	298	392	594	136	90.1	447
5	1,680	107.2	1,055	37.0	191	333	803	88.3	77.3	610
6	1,680	145.3	1,122	50.2	539	166	1,184	265	41.0	956
7	700	0	352	3.8	299	475	98	46.1	36.8	24.8
8	2,800	191.9	1,681	73.8	1,493	101	973	1,100	37.4	1,178
9	2,800	143.9	1,530	57.0	1,391	226	565	933	76.1	622
10	2,800	95.9	1,490	43.0	724	547	466	473	179	500
11	2,800	48.0	1,477	30.3	808	630	293	523	205	312
12	2,800	3.7	1,467	20.2	1,055	1,188	114	678	383	120
13	700	0	351	2.8	292	499	110	44.9	38.5	27.8

==Composite Cycle Emissions, 13-mode cycle==

BSCO	5.71	g/bhp-hr
BSHC	1.77	g/bhp-hr
$BSNO_2$	6.07	g/bhp-hr
BSFC	.440	lb/bhp-hr

*NO_x data are corrected to 75 grains H_2O/lb humidity.

==Test Conditions==

Barometer 736.3 mmHg
Humidity 57 grains of H_2O/lb dry air
Maximum inlet restriction 24 inches H_2O
Maximum exhaust back pressure 34 inches H_2O
Inlet air temperature 71° F
Maximum exhaust temperature 1,285° F
EGR rate at 75 pct load and rated speed 9.4 pct

TABLE B-3. - **Gaseous emissions for diesel engine at 322 engine hours, 273 hours with retarded timing and EGR, and 176 hours on catalysts**

[Exhaust sampled upstream of catalytic converters]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO2,* g/hr
1	575	0	325	2.3	284	497	106	40.5	35.5	24.8
2	1,680	2.9	1,004	8.8	511	658	99	225	145	71.6
3	1,680	36.2	1,012	17.0	497	473	278	220	105	203
4	1,680	72.0	1,023	27.0	289	375	471	130	84.4	347
5	1,680	108.2	1,006	38.0	203	318	602	89.5	70.4	436
6	1,680	144.0	1,130	53.3	536	231	928	265.5	57.4	755
7	575	0	352	2.6	266	381	123	41.0	29.5	31.2
8	2,800	191.9	1,693	78.3	1,422	196	844	1,055	73.0	1,029
9	2,800	143.9	1,487	61.3	1,357	237	504	884	77.5	540
10	2,800	95.9	1,470	44.3	748	485	369	482	157	391
11	2,800	48.0	1,457	30.8	747	497	248	477	159	260
12	2,800	3.7	1,447	21.2	1,034	924	95	656	294	99.0
13	575	0	325	2.4	287	393	94	40.9	28.1	22.0

==Composite Cycle Emissions, 13-mode cycle==

BSCO	5.42	g/bhp-hr
BSHC	1.54	g/bhp-hr
$BSNO_2$	4.96	g/bhp-hr
BSFC	.455	lb/bhp-hr

*NO_x data are corrected to 75 grains H_2O/lb humidity.

==Test Conditions==

Barometer 739.4 mmHg
Humidity 58 grains H_2O/lb dry air
Maximum inlet restriction 24 inches H_2O
Maximum exhaust back pressure 33.5 inches H_2O
Inlet air temperature 70° F
Maximum exhaust temperature 1,284° F
EGR rate at 75 pct load and rated speed 9.4 pct

TABLE B-3. - Gaseous emissions for diesel engine at 322 engine hours, 273 hours with retarded timing and EGR, and 176 hours on catalysts-Continued

[Exhaust sampled downstream of catalytic converters]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	575	0	325	2.2	257	352	101	36.6	25.2	23.6
2	1,680	2.9	1,004	8.8	491	664	96	216	147	69.4
3	1,680	36.2	1,012	17.0	26	139	273	11.5	30.9	199
4	1,680	72.0	1,023	27.3	12	58	444	5.38	13.1	327
5	1,680	108.2	1,006	37.3	17	40	549	7.50	8.85	398
6	1,680	144.0	1,130	53.7	24	35	907	11.9	8.70	738
7	575	0	352	2.7	243	306	109	37.5	23.7	27.6
8	2,800	191.9	1,693	78.8	28	46	844	20.8	17.1	1,029
9	2,800	143.9	1,487	61.4	28	69	504	18.2	22.6	540
10	2,800	95.9	1,470	44.3	29	58	441	18.7	18.8	467
11	2,800	48.0	1,457	31.0	26	81	248	16.6	26.0	260
12	2,800	3.7	1,447	21.0	21	133	104	13.3	42.3	108
13	575	0	325	2.5	275	312	99	39.2	22.3	23.2

==Composite Cycle Emissions, 13-mode cycle==

BSCO	0.51	g/bhp-hr
BSHC	.47	g/bhp-hr
$BSNO_2$	4.96	g/bhp-hr
BSFC	.456	lb/bhp-hr

==Test Conditions==

Barometer 739.4 mmHg
Humidity 58 grains H_2O/lb dry air
Maximum inlet restriction 24 inches H_2O
Maximum exhaust back pressure 33.5 inches H_2O
Inlet air temperature 70° F
Maximum exhaust temperature 1,284° F
EGR rate at 75 pct load and rated speed 9.4 pct

*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE B-4.- Gaseous emissions for diesel engine at 476 engine hours, 427 hours with retarded timing and EGR, and 330 hours on catalysts

[Exhaust sampled upstream of catalytic converters]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	575	0	324	2.0	305	441	117	43.3	31.4	27.3
2	1,680	2.9	1,029	8.7	541	576	120	244	130	88.9
3	1,680	36.2	1,037	16.5	483	384	320	220	87.6	239
4	1,680	72.0	1,020	27.0	277	306	527	124	68.7	387
5	1,680	108.2	1,005	38.0	206	312	645	90.7	69.0	467
6	1,680	144.0	1,128	53.2	620	174	980	307	43.2	796
7	575	0	324	2.0	293	240	128	41.6	17.1	29.9
8	2,800	194.0	1,691	79.4	1,379	192	929	1,022	71.4	1,131
9	2,800	145.5	1,485	61.4	1,544	216	569	1,005	70.6	608
10	2,800	97.0	1,469	45.2	837	432	458	539	140	484
11	2,800	48.5	1,453	30.2	748	432	294	476	138	308
12	2,800	3.7	1,443	17.7	1,014	804	121	641	255	126
13	575	0	351	2.0	302	360	106	46.5	27.8	26.8

==Composite Cycle Emissions, 13-mode cycle==

BSCO	5.61	g/bhp-hr
BSHC	1.33	g/bhp-hr
$BSNO_2$	5.52	g/bhp-hr
BSFC	.448	lb/bhp-hr

==Test Conditions==

Barometer 735.5 mmHg
Humidity 58 grains H_2O/lb dry air
Maximum inlet restriction 24 inches H_2O
Maximum exhaust back pressure 34 inches H_2O
Inlet air temperature 70° F
Maximum exhaust temperature 1,331° F
EGR rate at 75 pct load and rated speed 9.4 pct

*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE B-4. - Gaseous emissions for diesel engine at 476 engine hours, 427 hours with retarded timing and EGR, and 330 hours on catalysts-Continued

[Exhaust sampled downstream of catalytic converters]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	575	0	324	2.0	51	240	114	7.24	17.1	26.6
2	1,680	2.9	1,029	8.3	503	552	113	227	125	83.7
3	1,680	36.2	1,037	17.0	26	132	315	11.8	30.1	235
4	1,680	72.0	1,020	26.0	17	72	482	7.60	16.2	354
5	1,680	108.2	1,005	38.0	29	36	614	12.8	7.96	444
6	1,680	144.0	1,128	53.7	57	18	950	28.2	4.47	772
7	575	0	324	2.0	27	48	116	3.83	3.42	27.1
8	2,800	194.0	1,691	79.5	77	48	951	57.1	17.9	1,158
9	2,800	145.5	1,485	61.6	53	48	574	34.5	15.7	614
10	2,800	97.0	1,469	45.3	54	84	458	34.8	27.1	484
11	2,800	48.5	1,453	30.2	43	72	303	27.4	23.0	317
12	2,800	3.7	1,443	20.0	39	198	116	24.7	62.9	121
13	575	0	351	2.2	267	264	99	41.1	20.4	25.0

==Composite Cycle Emissions, 13-mode cycle==

BSCO	0.60	g/bhp-hr
BSHC	.43	g/bhp-hr
$BSNO_2$	5.46	g/bhp-hr
BSFC	.451	lb/bhp-hr

*NO_x data are corrected to 75 grains H_2O/lb humidity.

==Test Conditions==

Barometer 735.5 mmHg
Humidity 58 grains H_2O/lb dry air
Maximum inlet restriction 24 inches H_2O
Maximum exhaust back pressure 34.0 inches H_2O
Inlet air temperature 70° F
Maximum exhaust temperature 1,331° F
EGR rate at 75 pct load and rated speed 9.4 pct

TABLE B-5. - Gaseous emissions for diesel engine at 528 engine hours, 479 hours with retarded timing and EGR, and 382 hours on catalysts

[Exhaust sampled upstream of catalytic converters]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	575	0	351	2.7	310	335	133	47.7	25.9	33.6
2	1,680	2.9	1,028	9.2	555	579	119	250	131	88.1
3	1,680	36.5	1,010	17.6	506	417	317	224	92.7	231
4	1,680	72.6	1,020	28.2	293	324	487	131	72.7	358
5	1,680	109.1	1,007	41.2	218	382	619	96.2	84.6	449
6	1,680	144.0	1,128	55.0	736	185	936	364	45.9	760
7	575	0	351	2.4	311	382	142	47.8	29.5	35.9
8	2,800	197.2	1,691	82.2	1,559	232	919	1,155	86.3	1,119
9	2,800	148.2	1,486	65.0	1,722	214	579	1,122	70.0	619
10	2,800	98.6	1,469	47.2	777	504	469	500	163	496
11	2,800	49.6	1,453	31.8	730	486	300	465	155	314
12	2,800	3.7	1,442	20.5	1,013	950	117	640	301	121
13	575	0	351	2.7	338	400	128	52.0	30.9	32.3

==Composite Cycle Emissions, 13-mode cycle==

BSCO	5.88	g/bhp-hr
BSHC	1.48	g/bhp-hr
$BSNO_2$	5.38	g/bhp-hr
BSFC	.468	lb/bhp-hr

==Test Conditions==

Barometer 737 mmHg
Humidity 61 grains H_2O/lb dry air
Maximum inlet restriction 24 inches H_2O
Maximum exhaust back pressure 34.5 inches H_2O
Inlet air temperature 71° F
Maximum exhaust temperature 1,355° F
EGR rate at 75 pct load and rated speed 9.7 pct

*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE B-5. - Gaseous emissions for diesel engine at 528 engine hours, 479 hours with retarded timing and EGR, and 382 hours on catalysts-Continued

[Exhaust sampled downstream of catalytic converters]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	575	0	351	2.7	229	217	128	35.2	16.8	32.3
2	1,680	2.9	1,028	9.2	535	544	114	241	123	84.4
3	1,680	36.5	1,010	17.6	26	145	307	11.5	32.2	223
4	1,680	72.6	1,020	28.2	25	81	456	11.2	18.2	335
5	1,680	109.1	1,007	41.2	25	46	592	11.0	10.2	429
6	1,680	144.0	1,128	54.2	24	52	945	11.9	12.9	767
7	575	0	351	2.4	239	226	135	36.8	17.5	34.1
8	2,800	197.2	1,691	82.2	40	46	946	29.6	17.1	1,152
9	2,800	148.2	1,486	64.2	28	41	579	18.2	13.4	619
10	2,800	98.6	1,469	46.8	29	93	469	18.7	30.1	496
11	2,800	49.6	1,453	31.8	26	81	305	16.6	25.9	319
12	2,800	3.7	1,442	20.6	30	232	117	19.0	73.6	121
13	575	0	351	2.7	306	290	112	47.1	22.4	28.3

==Composite Cycle Emissions, 13-mode cycle==

BSCO	0.56	g/bhp-hr
BSHC	.47	g/bhp-hr
$BSNO_2$	5.36	g/bhp-hr
BSFC	.466	lb/bhp-hr

==Test Conditions==

Barometer 737 mmHg
Humidity 61 grains H_2O/lb dry air
Maximum inlet restriction 24 inches H_2O
Maximum exhaust back pressure 34.5 inches H_2O
Inlet air temperature 71° F
Maximum exhaust temperature 1,355° F
EGR rate at 75 pct load and rated speed 9.7 pct

*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE B-6. - Gaseous emissions for diesel engine at 653 engine hours, 604 hours with retarded timing and EGR, and 507 hours on catalysts

[Exhaust sampled upstream of catalytic converters]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	575	0	355	2.1	285	412	121	44.3	32.2	30.9
2	1,680	2.9	1,013	8.7	540	624	96	240	139	70.0
3	1,680	36.0	1,050	17.9	516	484	264	237	112	200
4	1,680	72.1	1,032	27.8	294	384	453	133	87.2	337
5	1,680	108.1	1,017	40.0	222	367	602	99.0	82.1	441
6	1,680	144.2	1,140	54.0	620	222	946	310	55.7	776
7	575	0	355	2.2	307	345	135	47.8	26.9	34.5
8	2,800	197.2	1,711	82.3	1,602	267	901	1,201	101	1,110
9	2,800	148.2	1,503	64.3	1,836	245	537	1,209	81.0	581
10	2,800	98.6	1,485	46.2	821	468	439	534	153	469
11	2,800	49.6	1,470	31.3	828	512	267	533	166	283
12	2,800	3.7	1,459	20.3	1,098	946	100	702	304	105
13	575	0	382	2.2	349	356	113	58.4	29.9	31.1

==Composite Cycle Emissions, 13-mode cycle==

BSCO	6.19	g/bhp-hr
BSHC	1.57	g/bhp-hr
$BSNO_2$	5.17	g/bhp-hr
BSFC	.463	lb/bhp-hr

*NO_x data are corrected to 75 grains H_2O/lb humidity.

==Test Conditions==

Barometer 746 mmHg
Humidity 66 grains H_2O/lb dry air
Maximum inlet restriction 24 inches H_2O
Maximum exhaust back pressure 35.5 inches H_2O
Inlet air temperature 71° F
Maximum exhaust temperature 1,327° F
EGR rate at 75 pct load and rated speed 10.2 pct

TABLE B-6. - Gaseous emissions for diesel engine at 653 engine hours, 604 hours with retarded timing and EGR, and 507 hours on catalysts-Continued

[Exhaust sampled downstream of catalytic converters]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	575	0	355	2.1	276	295	114	42.9	23.0	29.1
2	1,680	2.9	1,013	8.7	536	651	101	238	145	73.7
3	1,680	36.0	1,050	17.9	35	189	288	16.1	43.7	218
4	1,680	72.1	1,032	27.8	21	78	453	9.50	17.7	337
5	1,680	108.1	1,017	40.0	28	56	566	12.5	12.5	414
6	1,680	144.2	1,140	54.0	28	61	925	14.0	15.3	759
7	575	0	355	2.2	276	245	138	42.9	19.1	35.3
8	2,800	197.2	1,711	82.3	44	84	923	33.0	31.6	1,137
9	2,800	148.2	1,503	64.3	36	84	561	23.7	27.8	607
10	2,800	98.6	1,485	46.2	51	106	444	33.2	34.6	475
11	2,800	49.6	1,470	31.3	43	78	285	27.7	25.2	302
12	2,800	3.7	1,459	20.3	86	267	107	55.0	85.7	112
13	575	0	382	2.2	330	267	111	55.3	22.4	30.5

=Composite Cycle Emissions, 13-mode cycle=

BSCO	0.67	g/bhp-hr
BSHC	.57	g/bhp-hr
$BSNO_2$	5.24	g/bhp-hr
BSFC	.463	lb/bhp-hr

*NO_x data are corrected to 75 grains H_2O/lb humidity.

=Test Conditions=

Barometer 746 mmHg
Humidity 66 grains H_2O/lb dry air
Maximum inlet restriction 24 inches H_2O
Maximum exhaust back pressure 35.5 inches H_2O
Inlet air temperature 71° F
Maximum exhaust temperature 1,327° F
EGR rate at 75 pct load and rated speed 10.2 pct

TABLE B-7. - Gaseous emissions for diesel engine at 782 engine hours, 733 hours with retarded timing and EGR, and 636 hours on catalysts

[Exhaust sampled upstream of catalytic converters]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	575	0	352	1.9	303	373	142	46.7	28.9	36.0
2	1,680	2.9	1,031	8.2	606	633	94	274	144	69.8
3	1,680	36.8	1,012	16.2	532	430	252	236	95.7	184
4	1,680	73.6	1,007	27.2	302	328	444	133	73.7	322
5	1,680	110.3	1,007	38.7	240	452	584	106	100	423
6	1,680	147.1	1,130	53.7	738	215	900	366	53.4	732
7	575	0	352	2.2	267	328	150	41.2	25.4	38.0
8	2,800	199.4	1,696	82.0	1,685	266	943	1,253	99.2	1,152
9	2,800	149.8	1,464	64.5	1,702	271	563	1,092	87.3	593
10	2,800	99.7	1,472	46.3	720	481	463	465	156	491
11	2,800	50.1	1,457	30.8	862	526	254	550	169	266
12	2,800	3.7	1,446	19.8	1,120	1,035	96	710	329	100
13	575	0	352	1.8	331	418	114	51.1	32.4	28.9

═Composite Cycle Emissions, 13-mode cycle═

BSCO	6.07	g/bhp-hr
BSHC	1.58	g/bhp-hr
$BSNO_2$	5.06	g/bhp-hr
BSFC	.449	lb/bhp-hr

*NO_x data are corrected to 75 grains H_2O/lb humidity.

═Test Conditions═

Barometer 739.4 mmHg
Humidity 75 grains H_2O/lb dry air
Maximum inlet restriction 24 inches H_2O
Maximum exhaust back pressure 34 inches H_2O
Inlet air temperature 71° F
Maximum exhaust temperature 1,354° F
EGR rate at 75 pct load and rated speed 10.1 pct

TABLE B-7. - Gaseous emissions for diesel engine at 782 engine hours, 733 hours with retarded timing and EGR, and 636 hours on catalysts-Continued

[Exhaust sampled downstream of catalytic converters]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	575	0	352	1.9	285	288	134	44.0	22.3	34.0
2	1,680	2.9	1,031	3.2	601	684	98	272	155	72.7
3	1,680	36.8	1,012	16.2	35	147	290	15.5	32.7	211
4	1,680	73.6	1,007	27.2	12	68	435	5.30	15.1	315
5	1,680	110.3	1,007	38.7	17	51	548	7.50	11.3	397
6	1,680	147.1	1,130	53.7	16	51	900	7.92	12.7	732
7	575	0	352	2.2	217	237	178	33.5	18.4	45.1
8	2,800	199.4	1,696	82.0	32	79	954	23.8	29.5	1,165
9	2,800	149.8	1,464	64.5	25	74	586	16.0	23.8	618
10	2,800	99.7	1,472	46.3	37	102	449	23.9	33.0	476
11	2,800	50.1	1,457	30.8	30	25	278	19.2	8.01	292
12	2,800	3.7	1,446	19.8	74	368	103	46.9	117	107
13	575	0	352	1.8	326	305	104	50.3	23.6	26.4

==Composite Cycle Emissions, 13-mode cycle==

BSCO	0.62	g/bhp-hr
BSHC	.56	g/bhp-hr
$BSNO_2$	5.12	g/bhp-hr
BSFC	.449	lb/bhp-hr

==Test Conditions==

Barometer 739.4 mmHg
Humidity 75 grains H_2O/lb dry air
Maximum inlet restriction 23 inches H_2O
Maximum exhaust back pressure 34 inches H_2O
Inlet air temperature 71° F
Maximum exhaust temperature 1,354° F
EGR rate at 75 pct load and rated speed 10.1 pct

*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE B-8. - Gaseous emissions for diesel engine at 893 engine hours, 844 hours with retarded timing and EGR, and 747 hours on catalysts

[Exhaust sampled upstream of catalytic converters]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	575	0	355	1.2	281	391	153	43.7	30.5	39.1
2	1,680	2.9	1,014	7.2	532	621	104	236	139	75.9
3	1,680	36.8	1,023	16.7	512	467	320	230	105	236
4	1,680	73.3	1,034	27.3	276	321	544	125	73.0	405
5	1,680	110.0	1,018	39.2	223	433	663	99.5	97.0	486
6	1,680	146.2	1,141	52.8	593	188	1,001	297	47.2	822
7	575	0	355	1.1	300	314	174	46.7	24.5	44.5
8	2,800	198.9	1,713	80.7	1,606	237	977	1,206	89.3	1,205
9	2,800	149.8	1,478	63.8	1,812	251	620	1,174	81.6	660
10	2,800	99.7	1,470	45.2	833	614	493	537	199	522
11	2,800	50.1	1,456	31.0	884	614	317	564	197	332
12	2,800	3.7	1,444	18.8	1,057	1,018	115	669	323	120
13	575	0	355	1.2	323	537	140	50.3	41.9	35.8

==Composite Cycle Emissions, 13-mode cycle==

BSCO	6.03	g/bhp-hr
BSHC	1.64	g/bhp-hr
$BSNO_2$	5.70	g/bhp-hr
BSFC	.442	lb/bhp-hr

==Test Conditions==

Barometer 747.4 mmHg
Humidity 64 grains H_2O/lb dry air
Maximum inlet restriction 24 inches H_2O
Maximum exhaust back pressure 34 inches H_2O
Inlet air temperature 71° F
Maximum exhaust temperature 1,344° F
EGR rate at 75 pct load and rated speed 9.6 pct

*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE B-8. - Gaseous emissions for diesel engine at 893 engine hours, 844 hours with retarded timing and EGR, and 747 hours on catalysts-Continued

[Exhaust sampled downstream of catalytic converters]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	575	0	355	1.2	277	321	138	43.1	25.1	35.3
2	1,680	2.9	1,014	7.2	508	628	101	226	140	73.7
3	1,680	36.8	1,023	16.7	47	209	325	21.1	47.0	239
4	1,680	73.3	1,034	27.3	21	77	516	9.52	17.5	384
5	1,680	110.0	1,018	39.2	33	77	663	14.7	17.2	486
6	1,680	146.2	1,141	52.8	33	63	1,001	16.5	15.8	822
7	575	0	355	1.1	268	258	163	41.7	20.1	41.7
8	2,800	198.9	1,713	80.7	52	91	999	39.0	34.3	1,232
9	2,800	149.8	1,478	63.8	57	98	632	36.9	31.9	673
10	2,800	99.7	1,470	45.2	63	112	520	40.6	36.2	550
11	2,800	50.1	1,456	31.0	55	140	317	35.1	44.8	332
12	2,800	3.7	1,444	18.8	92	314	123	58.2	99.8	128
13	575	0	355	1.2	313	321	130	48.7	25.1	33.2

=Composite Cycle Emissions, 13-mode cycle=

BSCO	0.70	g/bhp-hr
BSHC	.62	g/bhp-hr
$BSNO_2$	5.75	g/bhp-hr
BSFC	.442	lb/bhp-hr

=Test Conditions=

Barometer 747.4 mmHg
Humidity 64 grains H_2O/lb dry air
Maximum inlet restriction 24 inches H_2O
Maximum exhaust back pressure 34 inches H_2O
Inlet air temperature 71° F
Maximum exhaust temperature 1,344° F
EGR rate at 75 pct load and rated speed 9.6 pct

*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE B-9. - Gaseous emissions for diesel engine at 1,018 engine hours, 969 hours with retarded timing and EGR, and 872 hours on catalysts

[Exhaust sampled upstream of catalytic converter]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	575	0	352	1.6	285	361	142	44.0	28.0	36.0
2	1,680	2.9	1,033	7.8	576	633	95	261	144	70.7
3	1,680	36.8	1,015	16.1	513	436	277	228	97.4	202
4	1,680	73.6	1,009	26.3	273	313	479	121	59.5	348
5	1,680	110.3	1,010	38.7	214	421	627	94.7	93.5	456
6	1,680	147.1	1,133	53.4	679	170	989	337	42.4	807
7	575	0	353	1.8	280	296	164	43.3	23.0	41.7
8	2,800	200.4	1,702	82.1	1,982	215	966	1,479	80.5	1,184
9	2,800	150.3	1,493	62.6	2,189	235	592	1,432	77.2	636
10	2,800	100.2	1,475	44.2	919	546	472	594	177	501
11	2,800	50.1	1,460	29.1	841	554	270	538	178	284
12	2,800	3.7	1,450	19.6	1,142	1,162	104	726	371	109
13	575	0	353	2.0	335	404	127	51.8	31.4	32.3

==Composite Cycle Emissions, 13-mode cycle==

BSCO	6.77	g/bhp-hr
BSHC	1.60	g/bhp-hr
$BSNO_2$	5.36	g/bhp-hr
BSFC	.439	lb/bhp-hr

==Test Conditions==

Barometer 739.2 mmHg
Humidity 70 grains H_2O/lb dry air
Maximum inlet restriction 24 inches H_2O
Maximum exhaust back pressure 34 inches H_2O
Inlet air temperature 70° F
Maximum exhaust temperature 1,366° F
EGR rate at 75 pct load and rated speed 9.4 pct

*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE B-9. - Gaseous emissions for diesel engine at 1,018 engine hours, 969 hours with retarded timing and EGR, and 872 hours on catalysts-Continued

[Exhaust sampled downstream of catalytic converters]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	575	0	352	1.6	259	233	148	40.0	18.0	37.5
2	1,680	2.9	1,033	7.8	556	640	103	252	145	76.6
3	1,680	36.8	1,015	16.1	104	270	308	46.3	60.3	225
4	1,680	73.6	1,009	26.3	9	77	487	3.98	17.1	354
5	1,680	110.3	1,010	38.7	17	73	608	7.53	16.2	442
6	1,680	147.1	1,133	53.4	20	58	973	9.93	14.5	794
7	575	0	353	1.8	262	227	176	40.5	17.6	44.7
8	2,800	200.4	1,702	82.1	36	65	965	26.9	24.3	1,183
9	2,800	150.3	1,493	62.6	33	65	594	21.6	21.3	639
10	2,800	100.2	1,475	44.2	54	120	463	34.9	38.9	492
11	2,800	50.1	1,460	29.1	47	124	300	30.1	39.8	315
12	2,800	3.7	1,450	19.6	118	456	111	75.0	145	116
13	575	0	353	2.0	307	285	150	47.5	22.1	38.1

═Composite Cycle Emissions, 13-mode cycle═

BSCO	0.70	g/bhp-hr
BSHC	.65	g/bhp-hr
$BSNO_2$	5.41	g/bhp-hr
BSFC	.439	lb/bhp-hr

═Test Conditions═

Barometer 739.2 mmHg
Humidity 70 grains H_2O/lb dry air
Maximum inlet restriction 24 inches H_2O
Maximum exhaust back pressure 34 inches H_2O
Inlet air temperature 70° F
Maximum exhaust temperature 1,366° F
EGR rate at 75 pct load and rated speed 9.4 pct

*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE B-10. - Gaseous emissions for diesel engine at 1,135 engine hours, 1,086 hours with retarded timing and EGR, and 989 hours on catalysts

[Exhaust sampled upstream of catalytic converters]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	575	0	356	2.3	335	268	128	52.1	21.0	32.9
2	1,680	2.9	1,013	7.5	602	590	93	267	131	67.9
3	1,680	35.8	1,006	17.5	502	450	265	221	99.7	192
4	1,680	71.7	1,006	27.9	275	322	473	121	71.2	342
5	1,680	107.5	1,018	40.2	248	359	730	111	80.5	535
6	1,680	143.3	1,142	55.6	787	166	866	394	41.8	712
7	575	0	356	2.7	275	327	139	42.9	25.6	35.5
8	2,800	191.9	1,712	82.2	1,940	188	878	1,456	70.7	1,083
9	2,800	143.9	1,476	63.2	2,052	236	531	1,328	76.6	564
10	2,800	96.0	1,459	46.5	1,056	556	414	675	178	435
11	2,800	48.0	1,444	31.9	915	562	276	579	178	287
12	2,800	3.7	1,434	21.4	1,202	602	97	756	190	100
13	575	0	383	2.7	293	390	113	49.2	32.8	31.2

==Composite Cycle Emissions, 13-mode cycle==

BSCO	7.14	g/bhp-hr
BSHC	1.40	g/bhp-hr
$BSNO_2$	5.21	g/bhp-hr
BSFC	.474	lb/bhp-hr

==Test Conditions==

Barometer 744 mmHg
Humidity 65 grains H_2O/lb dry air
Maximum inlet restriction 24 inches H_2O
Maximum exhaust back pressure 35 inches H_2O
Inlet air temperature 70° F
Maximum exhaust temperature 1,361° F
EGR rate at 75 pct load and rated speed 9.7 pct

*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE B-10. - **Gaseous emissions for diesel engine at 1,135 engine hours, 1,086 hours with retarded timing and EGR, and 989 hours on catalysts-Continued**

[Exhaust sampled downstream of catalytic converters]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	575	0	356	2.3	316	209	125	49.2	16.3	32.4
2	1,680	2.9	1,013	7.5	596	574	98	264	128	71.3
3	1,680	35.8	1,006	17.5	78	320	270	34.4	70.8	195
4	1,680	71.7	1,006	27.9	26	182	464	11.2	40.3	336
5	1,680	107.5	1,018	40.2	28	70	734	12.7	15.7	538
6	1,680	143.3	1,142	55.6	28	48	844	13.9	12.1	694
7	575	0	356	2.7	257	247	131	40.1	19.3	33.6
8	2,800	191.9	1,712	82.2	44	48	878	33.1	18.1	1,083
9	2,800	143.9	1,476	63.2	41	86	527	26.5	27.9	560
10	2,800	96.0	1,459	46.5	63	103	432	40.0	33.1	454
11	2,800	48.0	1,444	31.9	47	115	272	29.6	36.5	283
12	2,800	3.7	1,434	21.4	82	304	129	51.8	95.9	133
13	575	0	383	2.7	298	298	113	50.0	25.1	31.2

==Composite Cycle Emissions, 13-mode cycle==

BSCO	0.75	g/bhp-hr
BSHC	.63	g/bhp-hr
$BSNO_2$	5.24	g/bhp-hr
BSFC	.474	lb/bhp-hr

==Test Conditions==

Barometer 744 mmHg
Humidity 65 grains H_2O/lb dry air
Maximum inlet restriction 24 inches H_2O
Maximum exhaust back pressure 35 inches H_2O
Inlet air temperature 70° F
Maximum exhaust temperature 1,361° F
EGR rate at 75 pct load and rated speed 9.7 pct

*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE B-11. - Gaseous emissions for diesel engine at 1,210 engine hours, 1,161 hours with retarded timing and EGR, and 1,064 hours on catalysts

[Exhaust sampled upstream of catalytic converters]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	600	0	352	1.8	276	382	143	42.6	29.6	36.2
2	1,680	2.9	1,031	8.0	616	637	100	278	144	74.2
3	1,680	36.1	1,039	16.4	532	434	271	242	99.2	203
4	1,680	72.0	1,051	27.8	298	440	498	137	102	377
5	1,680	108.1	1,034	38.2	249	475	584	113	108	435
6	1,680	143.9	1,157	53.8	884	371	882	448	94.4	735
7	600	0	352	1.8	294	376	177	45.4	29.1	44.9
8	2,800	197.2	1,723	80.8	1,860	347	861	1,405	132	1,068
9	2,800	148.2	1,259	61.2	1,542	423	536	851	117	486
10	2,800	98.6	1,525	44.2	704	492	431	471	165	473
11	2,800	49.6	1,510	29.8	838	544	260	555	181	283
12	2,800	3.7	1,500	19.6	1,037	1,019	103	682	336	111
13	600	0	351	1.3	309	425	135	47.5	32.8	34.1

==Composite Cycle Emissions, 13-mode cycle==

BSCO	6.16	g/bhp-hr
BSHC	1.81	g/bhp-hr
$BSNO_2$	5.05	g/bhp-hr
BSFC	.446	lb/bhp-hr

==Test Conditions==

Barometer 742.1 mmHg
Humidity 61 grains H_2O/lb dry air
Maximum inlet restriction 24 inches H_2O
Maximum exhaust back pressure 34 inches H_2O
Inlet air temperature 72° F
Maximum exhaust temperature 1,250° F
EGR rate at 75 pct load and rated speed 10.7 pct

*NO_x data are corrected to 75 grains H_2O/lb humidity.

NOTE.-New injectors installed and reset injection timing from 3.5° retarded to 3° retarded.

TABLE B-11. - Gaseous emissions for diesel engine at 1,210 engine hours, 1,161 hours with retarded timing and EGR, and 1,064 hours on catalysts-Continued

[Exhaust sampled downstream of catalytic converters]

Mode	Engine speed, rpm	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	CO, ppm	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	600	0	352	1.9	248	320	169	38.3	24.8	42.8
2	1,680	2.9	1,031	8.0	561	628	100	254	142	74.2
3	1,680	36.1	1,039	16.3	104	271	269	47.4	61.9	201
4	1,680	72.0	1,025	29.2	17	108	467	7.64	24.4	345
5	1,680	108.1	1,007	38.0	29	101	552	12.8	22.4	400
6	1,680	143.9	1,130	53.3	32	86	866	15.8	21.4	705
7	600	0	352	1.8	200	271	162	30.9	21.0	41.1
8	2,800	197.2	1,722	80.4	41	98	856	30.9	37.1	1,061
9	2,800	148.2	1,541	61.2	45	98	536	30.4	33.2	595
10	2,800	98.6	1,524	43.8	46	111	430	30.7	37.2	472
11	2,800	49.6	1,483	30.0	30	108	280	19.5	35.2	299
12	2,800	3.7	1,473	19.3	130	390	114	83.9	126	121
13	600	0	352	1.8	258	310	131	39.8	24.0	33.2

==Composite Cycle Emissions, 13-mode cycle==

BSCO	0.73	g/bhp-hr
BSHC	.70	g/bhp-hr
$BSNO_2$	5.08	g/bhp-hr
BSFC	.446	lb/bhp-hr

==Test Conditions==

Barometer 742 mmHg
Humidity 64 grains H_2O/lb dry air
Maximum inlet restriction 24 inches H_2O
Maximum exhaust back pressure 34 inches H_2O
Inlet air temperature 72° F
Maximum exhaust temperature 1,249° F
EGR rate at 75 pct load and rated speed 10.7 pct

*NO_x data are corrected to 75 grains H_2O/lb humidity.

NOTE.-New injectors installed and reset injection timing from 3.5° retarded to 3° retarded.

APPENDIX C.--BASELINE EMISSIONS DATA FOR THE GASOLINE ENGINE

TABLE C-1. - Baseline emissions (23-mode cycle) for gasoline engine adjusted to manufacturer's specifications (no EGR, no manifold air injection, and no catalysts)

[Test No. 1--18 engine hours]

Mode	Engine speed, rpm	Observed power, bhp	Manifold vacuum, " Hg	Exhaust flow, lb/hr	Fuel flow, lb/hr	Ignition timing, ° btc	CO, pct	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	Idle	0	18.0	91	5.6	0	0.48	1,506	75	193.8	30.1	4.9
2	1,200	1.1	19.5	141	8.5	15	.71	3,954	85	445.2	122.7	8.7
3	1,200	4.3	18.5	153	9.1	15	.35	1,294	137	240.4	44.0	15.4
4	1,200	9.6	17.5	164	10.0	15	.50	1,247	255	363.9	44.9	30.5
5	1,200	13.2	16.0	167	10.1	15	.39	1,341	383	291.3	49.6	47.0
6	1,200	26.5	10.5	257	14.9	14	.16	1,412	960	182.3	79.7	180.0
7	1,200	39.7	4.0	336	19.6	5	.16	871	1,228	239.0	64.4	301.6
8	1,200	43.4	3.0	376	22.5	6.5	.21	1,035	1,534	355.2	86.7	426.4
9	1,200	48.6	2.5	390	25.1	6.5	.97	1,577	1,543	1,695.2	136.4	443.2
10	1,200	53.0	0	441	32.8	6.5	5.10	2,542	873	9,952.8	245.6	280.1
11	Idle	0	18.0	83	5.1	0	.41	1,271	77	151.8	23.3	4.7
12	1,200	0	22.5	87	5.2	6	.54	38,241	17	208.3	730.4	1.1
13	2,300	109.0	1.0	831	61.8	15	5.00	2,118	955	18,529.3	388.6	581.8
14	2,300	100.3	3.0	723	49.0	15	1.94	1,694	1,380	6,284.3	271.7	734.8
15	2,300	89.3	4.0	708	44.5	15	.44	741	1,840	1,387.5	115.7	953.8
16	2,300	81.9	7.0	654	41.7	16	.53	1,012	1,779	1,554.1	146.9	857.4
17	2,300	54.3	11.5	494	30.5	25	.51	918	1,747	1,055.7	94.1	594.2
18	2,300	27.2	16.0	379	23.1	24.5	.39	435	774	659.8	36.4	215.3
19	2,300	19.7	17.3	322	19.4	24	.28	212	513	401.7	15.1	121.0
20	2,300	8.8	19.5	277	16.4	24	.20	118	267	246.1	7.2	54.1
21	2,300	2.2	20.5	246	14.4	24	.16	106	175	175.9	5.8	31.6
22	Idle	0	18.0	92	5.6	0	.36	1,294	74	149.3	26.6	5.0
23	2,300	0	22.0	177	10.7	24	.39	10,296	68	309.4	404.3	8.9

==Composite Cycle Emissions, 23-mode cycle==

BSCO	47.8	g/bhp-hr
BSHC	7.25	g/bhp-hr
$BSNO_2$	8.57	g/bhp-hr
BSFC	.691	lb/bhp-hr

==Test Conditions==

Barometer	740.0 mmHg
Humidity	48.8 grains H_2O/lb dry air
Inlet air temperature	75° F
Max. exhaust temperature	1,474° F

* NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE C-1. - Baseline emissions (23-mode cycle) for gasoline engine adjusted to manufacturer's specifications (no EGR, no manifold air injection, and no catalysts)-Continued

[Test No. 2--21 engine hours]

Mode	Engine speed, rpm	Observed power, bhp	Manifold vacuum, " Hg	Exhaust flow, lb/hr	Fuel flow, lb/hr	Ignition timing, ° btc	CO, pct	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g /hr	NO_2,* g/hr
1	Idle	0	17.0	82	4.9	0	0.32	2,035	66	116.9	36.8	4.0
2	1,200	1.1	19.6	144	8.4	15	.39	5,332	88	248.9	168.5	9.2
3	1,200	4.3	18.7	153	8.9	15	.21	1,212	133	141.4	40.4	14.8
4	1,200	9.6	17.4	164	9.9	15	.41	1,309	281	292.2	46.2	33.0
5	1,200	13.2	16.4	199	11.9	15	.25	1,212	436	216.7	52.0	62.1
6	1,200	26.5	11.4	251	14.6	15	.12	1,504	1,045	133.2	82.7	190.6
7	1,200	39.7	5.5	318	18.6	6	.19	1,042	1,166	268.3	72.8	270.6
8	1,200	43.4	3.8	365	22.0	6	.21	1,139	1,755	337.8	90.7	464.0
9	1,200	48.6	2.2	415	26.2	7	.77	1,527	1,602	1,436.3	141.0	491.2
10	1,200	53.0	.5	428	31.9	7	5.06	2,715	851	9,723.8	258.3	268.7
11	Idle	0	18.0	83	5.1	0	.48	1,503	80	178.2	27.6	4.9
12	1,200	0	21.8	81	5.0	6	.59	44,838	22	210.7	792.6	1.3
13	2,300	109.0	1.0	832	62.3	15	5.06	2,230	950	18,817.1	410.5	577.6
14	2,300	100.3	3.3	756	50.3	15	1.32	1,575	1,692	4,476.6	264.4	942.9
15	2,300	89.3	3.8	727	45.7	15	.38	763	1,868	1,237.3	123.0	999.7
16	2,300	81.9	5.6	673	42.9	15	.47	945	1,707	1,423.3	141.7	849.7
17	2,300	54.3	11.4	504	31.2	25	.44	933	1,604	996.7	104.6	597.2
18	2,300	27.2	16.2	352	21.4	25	.32	424	723	504.0	33.1	187.1
19	2,300	19.7	17.7	341	20.5	24	.21	218	528	320.7	16.5	132.6
20	2,300	8.8	19.3	338	20.0	24	.16	109	312	241.1	8.1	77.2
21	2,300	2.2	20.5	256	15.0	24	.14	133	195	161.3	7.6	36.9
22	Idle	0	17.9	84	5.1	0	.28	1,842	77	105.2	34.3	4.7
23	2,300	0	22.6	166	10.2	24	.48	15,451	61	356.9	568.7	7.5

==Composite Cycle Emissions, 23-mode cycle==

BSCO 42.1 g/bhp-hr
BSHC 8.14 g/bhp-hr
$BSNO_2$ 9.20 g/bhp-hr
BSFC .697 lb/bhp-hr

==Test Conditions==

Barometer 740.0
Humidity 52.0 grains H_2O/lb dry air
Inlet air temperature 76° F
Max. exhaust temperature 1,481° F

*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE C-1. - Baseline emissions (23-mode cycle) for gasoline engine adjusted to manufacturer's specifications (no EGR, no manifold air injection, and no catalysts)-Continued

[Test No. 3--24 engine hours]

Mode	Engine speed, rpm	Observed power, bhp	Manifold vacuum, " Hg	Exhaust flow, lb/hr	Fuel flow, lb/hr	Ignition timing, ° btc	CO, pct	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	Idle	0	17.5	85	5.1	0	0.32	1,836	75	120.8	34.3	4.6
2	1,200	1.1	19.5	130	7.7	15	.48	6,365	96	281.3	184.6	9.2
3	1,200	4.3	19.0	152	8.9	15	.28	1,469	141	190.6	49.5	15.8
4	1,200	9.6	17.5	174	10.7	15	.48	1,420	290	376.8	55.2	37.4
5	1,200	13.2	16.0	194	11.7	15	.32	1,469	431	278.0	63.2	61.5
6	1,200	26.5	11.0	264	15.4	15	.12	1,567	1,104	142.9	92.4	216.0
7	1,200	39.7	6.0	326	19.7	6	.37	1,248	1,230	544.7	91.0	297.7
8	1,200	43.4	3.5	399	24.2	6	.19	1,248	1,874	342.2	111.3	554.9
9	1,200	48.6	2.5	394	25.0	7	.84	1,640	1,606	1,498.6	144.8	471.1
10	1,200	53.0	0	414	30.8	7	4.94	2,791	898	9,226.5	258.1	275.7
11	Idle	0	18.0	79	4.8	0	.35	1,714	79	125.1	30.3	4.7
12	1,200	0	22.5	81	4.9	6	.53	44,064	18	192.1	790.5	1.1
13	2,300	109.0	1.0	806	59.8	15	4.76	2,154	998	17,434.1	390.6	600.9
14	2,300	100.3	3.5	743	49.9	15	1.60	1,689	1,617	5,359.3	280.1	890.4
15	2,300	89.3	4.0	717	45.0	15	.40	734	1,843	1,291.5	117.3	978.2
16	2,300	81.9	6.0	680	43.1	15	.44	857	1,741	1,342.8	129.5	873.4
17	2,300	54.3	11.5	505	31.1	25	.48	894	1,609	1,090.8	100.6	601.0
18	2,300	27.2	16.0	368	22.3	24	.34	416	744	545.3	33.0	196.1
19	2,300	19.7	17.5	313	18.8	23.5	.28	269	544	392.1	18.6	125.1
20	2,300	8.8	19.0	299	17.6	24	.19	110	315	253.2	7.3	69.0
21	2,300	2.2	20.0	238	13.9	23.5	.16	147	189	170.8	7.8	33.2
22	Idle	0	18.0	90	5.4	0	.32	1,958	76	127.8	38.7	5.0
23	2,300	0	22.5	172	11.0	24	.51	21,420	64	390.0	810.9	8.0

==Composite Cycle Emissions, 23-mode cycle==

BSCO	43.4	g/bhp-hr
BSHC	8.84	g/bhp-hr
$BSNO_2$	9.20	g/bhp-hr
BSFC	.696	lb/bhp-hr

==Test Conditions==

Barometer	739.5
Humidity	51.2 grains H_2O/lb dry air
Inlet air temperature	76° F
Max. exhaust temperature	1,480° F

*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE C-2. - Baseline emissions (23-mode cycle) for gasoline engine equipped with emission controls (standard ignition timing, manifold air injection, two platinum pelleted type catalysts, and 10 pct EGR)

[Test No. 1--80 engine hours and 15 hours on emission controls]

Mode	Engine speed, rpm	Observed power, bhp	Manifold vacuum, " Hg	Exhaust flow, lb/hr	Fuel flow, lb/hr	Ignition timing, ° btc	CO, pct	HC, ppmC	NOx,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	Idle	0	18.0	116	5.6	0	0.01	106	13	5.91	2.70	1.10
2	1,200	0.9	20.5	210	8.5	14	.01	377	56	9.02	16.2	7.98
3	1,200	3.9	19.0	221	9.3	16	.01	135	84	7.11	6.26	12.9
4	1,200	8.9	17.5	219	10.2	15	.01	71	160	10.2	3.40	25.4
5	1,200	12.3	17.5	238	11.3	15	.01	86	236	10.9	4.49	40.9
6	1,200	24.7	6.5	372	19.0	8	.005	40	284	8.51	3.24	76.4
7	1,200	36.8	4.0	436	23.0	8	.006	46	763	11.2	4.33	238
8	1,200	40.2	2.0	451	24.3	8	.01	68	1,006	20.1	6.64	326
9	1,200	45.2	2.0	468	26.2	8	.02	55	978	49.3	5.59	330
10	1,200	49.1	1.5	470	28.0	8	.06	51	942	118	5.18	318
11	Idle	0	18.5	111	5.4	0	.01	162	18	6.28	3.93	1.45
12	1,200	0	23.0	147	5.7	7	.005	586	25	3.70	18.8	2.67
13	2,300	107.7	1.0	949	63.5	15	1.96	280	587	8,094	57.2	398
14	2,300	99.0	2.5	863	52.5	15	.04	8	1,100	137	1.46	665
15	2,300	88.5	3.0	863	48.5	15	.007	6	1,300	26.8	1.15	831
16	2,300	81.0	4.0	815	46.5	15	.007	7	1,110	24.3	1.27	671
17	2,300	53.9	9.0	632	33.5	24	.006	14	646	18.3	1.95	299
18	2,300	27.2	13.0	503	25.2	24	.006	12	249	14.1	1.29	88.9
19	2,300	19.3	14.0	479	23.3	24	.006	20	169	12.4	2.08	58.5
20	2,300	8.8	16.5	403	18.5	24	.005	65	114	9.40	5.71	33.3
21	2,300	2.2	18.5	380	16.7	24	.005	165	88	8.74	13.7	24.3
22	Idle	0	18.5	124	6.0	0	.01	128	17	6.66	3.46	1.53
23	2,300	0	22.5	280	11.0	24	.007	530	48	8.43	32.5	9.78

==Composite Cycle Emissions, 23-mode cycle==

BSCO	8.87	g/bhp-hr
BSHC	.36	g/bhp-hr
$BSNO_2$	6.47	g/bhp-hr
BSFC	.771	lb/bhp-hr

*NO_x data are corrected to 75 grains H_2O/lb humidity.

==Test Conditions==

Barometer 743.8 mmHg
Humidity 48.7 grains H_2O/lb dry air
Inlet air temperature 75° F
Maximum exhaust temperature 1,420° F
Maximum catalyst temperature 1,550° F
Maximum exhaust back pressure 20 inches H_2O

TABLE C-2. - Baseline emissions (23-mode cycle) for gasoline engine equipped with emission controls (standard ignition timing, manifold air injection, two platinum pelleted type catalysts, and 10 pct EGR)-Continued

[Test No. 2--100 engine hours and 35 hours on emission controls]

Mode	Engine speed, rpm	Observed power, bhp	Manifold vacuum, " Hg	Exhaust flow, lb/hr	Fuel flow, lb/hr	Ignition timing, ° btc	CO, pct	HC, ppmC	NO_x,* ppm	CO, g/hr	HC, g/hr	NO_2,* g/hr
1	Idle	0	18.5	124	6.0	0	0.01	115	19	5.20	3.19	1.75
2	1,200	0.9	21.0	193	8.2	15	.009	497	72	7.82	21.4	10.3
3	1,200	3.9	19.5	215	9.2	15	.008	202	75	7.47	9.58	11.8
4	1,200	8.9	17.5	226	10.0	15	.006	104	145	6.19	5.23	24.2
5	1,200	12.3	17.0	254	11.9	15	.009	75	275	9.75	4.21	51.3
6	1,200	24.7	6.0	376	19.1	8	.006	35	347	10.2	2.93	96.5
7	1,200	36.8	4.0	524	27.8	8	.007	46	767	17.2	5.36	297
8	1,200	40.2	3.0	455	24.2	8	.008	87	1,008	16.3	8.77	337
9	1,200	45.2	2.0	527	29.0	8	.02	98	1,066	49.0	11.4	413
10	1,200	49.1	0	485	33.2	7	2.42	548	458	5,266	59.0	164
11	Idle	0	19.0	126	6.0	0	.01	92	21	6.62	2.56	1.94
12	1,200	0	23.0	156	6.0	15	.007	854	24	4.67	29.5	2.75
13	2,300	107.3	1.0	958	63.6	15	1.76	248	730	7,514	52.4	512
14	2,300	98.5	2.5	856	50.0	15	.01	17	1,587	48.3	3.18	985
15	2,300	88.0	3.0	861	48.0	15	.001	17	1,486	36.6	3.21	932
16	2,300	80.6	4.5	810	45.0	15	.009	11	1,217	30.0	1.90	698
17	2,300	53.4	9.0	636	33.3	24	.008	11	676	21.6	1.51	308
18	2,300	26.7	13.0	507	25.0	24	.007	17	224	15.6	1.93	84.4
19	2,300	19.3	14.5	473	22.6	24	.007	35	147	14.6	3.73	52.0
20	2,300	8.3	16.5	401	18.3	24	.006	115	110	11.0	10.3	32.6
21	2,300	2.2	18.5	374	16.2	24	.006	231	85	10.3	19.3	23.6
22	Idle	0	19.0	122	5.8	0	.008	115	21	4.25	3.14	1.91
23	2,300	0	22.5	271	10.5	24	.008	693	45	9.25	42.4	9.13

==Composite Cycle Emissions, 23-mode cycle==

BSCO	8.14	g/bhp-hr
BSHC	.47	g/bhp-hr
$BSNO_2$	7.62	g/bhp-hr
BSFC	.764	lb/bhp-hr

==Test Conditions==

Barometer 748.8 mmHg
Humidity 51.0 grains H_2O/lb dry air
Inlet air temperature 74° F
Maximum exhaust temperature 1,419° F
Maximum catalyst temperature 1,550° F
Maximum exhaust back pressure 23 inches H_2O

*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE C-3. - **Baseline emissions (9-mode cycle) for gasoline engine adjusted to manufacturer's specifications (no EGR, no manifold air injection, and no catalysts)**

[Test No. 1--27 engine hours]

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	grams/hr		
						CO	CO_2			CO	HC	NO_2*
1	1	0	83	5.0	15.6	0.32	11.66	1,804	77	119	33.6	4.76
	2	28	359	21.3	15.8	.30	11.69	1,182	850	483	94.4	255
	3	56	496	30.0	15.5	.32	11.85	1,454	1,918	706	160	704
	4	28	325	19.6	15.6	.32	11.85	955	950	463	69.2	229
	5	9	234	14.0	15.7	.28	11.67	403	365	301	21.3	64.1
	6	28	337	20.1	15.8	.25	11.68	963	923	378	73.0	232
	7	84	676	43.8	14.4	1.39	11.48	1,379	1,367	4,291	211	693
	8	28	321	19.8	15.2	.38	11.86	1,007	1,048	554	73.3	253
	9	0	151	9.8	14.4	1.09	10.96	8,211	143	764	283	16.4
2	1	0	83	5.0	15.6	.32	11.66	1,804	77	119	33.6	4.76
	2	28	352	20.9	15.8	.32	11.69	942	846	502	73.8	220
	3	56	497	30.1	15.5	.32	11.89	1,347	1,918	707	149	705
	4	28	332	20.0	15.6	.34	11.86	832	979	512	61.5	240
	5	9	228	13.6	15.8	.21	11.68	307	346	221	15.9	59.5
	6	28	333	20.0	15.7	.27	11.81	845	964	411	63.0	239
	7	84	676	44.1	14.3	1.42	11.52	1,314	1,412	4,401	201	718
	8	28	311	19.6	14.9	.37	12.65	876	1,033	503	59.4	233
	9	0	155	10.0	14.4	1.02	11.07	7,664	143	731	270	16.7
3	1	0	80	5.0	15.0	.52	12.07	1,314	85	189	23.4	5.06
	2	28	340	19.9	16.1	.25	11.61	942	848	377	71.1	213
	3	56	492	30.0	15.4	.36	11.88	1,314	1,902	800	145	695
	4	28	319	19.3	15.6	.32	11.89	854	1,036	455	60.8	245
	5	9	232	14.0	15.6	.22	11.85	285	378	233	15.0	65.8
	6	28	333	20.0	15.7	.32	11.74	854	941	478	63.8	234
	7	84	668	43.3	14.4	1.28	11.53	1,139	1,348	3,923	173	680
	8	28	324	20.0	15.2	.38	11.85	854	1,036	560	69.9	254
	9	0	149	9.7	14.4	1.02	11.29	7,116	152	699	240	17.0
4	1	0	80	5.0	15.0	.52	12.07	1,314	85	189	23.4	5.06
	2	28	338	20.1	15.8	.28	11.68	920	888	430	69.6	223
	3	56	492	30.0	15.4	.34	11.88	1,336	1,955	761	147	715
	4	28	332	20.1	15.5	.34	11.89	832	1,009	512	61.6	248
	5	9	234	14.0	15.7	.25	12.06	285	480	256	14.7	82.1
	6	28	332	20.0	15.6	.35	11.86	821	984	524	60.6	241
	7	84	683	44.0	14.5	1.23	11.54	1,314	1,444	3,834	203	742
	8	28	324	20.0	15.2	.38	11.86	854	1,033	560	62.9	253
	9	0	152	9.8	14.5	.96	11.08	7,401	152	673	257	17.6

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	33.4	g/bhp-hr
BSHC	4.11	g/bhp-hr
$BSNO_2$	10.0	g/bhp-hr
BSFC	.702	lb/bhp-hr

==Test Conditions==
Barometer 749.5 mmHg
Humidity 43.0 grains H_2O/lb dry air
Inlet air temperature 75° F

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* NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE C-3. - Baseline emissions (9-mode cycle) for gasoline engine adjusted to manufacturer's specifications (no EGR, no manifold air injection, and no catalysts)-Continued

[Test No. 2--29 engine hours]

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	grams/hr		
						CO	CO_2			CO	HC	NO_2*
1	1	0	97	6.0	15.1	0.53	12.09	1,596	77	230	34.0	5.47
	2	28	386	22.8	15.9	.33	11.84	1,162	875	555	97.9	245
	3	56	508	30.8	15.5	.34	12.04	1,419	1,851	772	158	686
	4	28	350	21.1	15.6	.33	11.94	931	968	509	72.1	249
	5	9	252	15.0	15.8	.24	11.80	364	373	271	20.5	69.7
	6	28	352	21.0	15.7	.32	11.91	887	910	495	68.5	234
	7	84	688	45.2	14.2	1.65	11.57	1,375	1,391	5,135	211	709
	8	28	331	20.2	15.4	.42	12.01	887	1,018	623	64.9	247
	9	0	151	9.8	14.4	1.16	11.12	6,790	152	807	232	17.4
2	1	0	97	6.0	15.1	.53	12.09	1,596	77	230	34.0	5.47
	2	28	357	21.2	15.8	.30	11.72	931	865	480	73.9	228
	3	56	509	30.8	15.5	.34	11.96	1,330	1,953	778	148	729
	4	28	349	21.0	15.6	.34	11.90	887	991	535	68.5	254
	5	9	252	15.0	15.8	.18	11.83	290	374	211	16.4	70.2
	6	28	349	21.0	15.6	.32	11.86	843	984	497	65.5	254
	7	84	692	45.0	14.4	1.42	11.67	1,220	1,450	4,444	188	744
	8	28	329	20.2	15.3	.38	11.91	812	1,022	564	60.2	252
	9	0	158	10.2	14.5	1.13	11.30	6,652	151	807	235	17.7
3	1	0	101	6.3	15.0	.57	11.99	1,197	79	259	27.0	5.91
	2	28	357	21.0	16.0	.26	11.70	976	718	422	77.1	188
	3	56	513	31.0	15.5	.33	11.95	1,341	1,952	763	152	734
	4	28	349	21.0	15.6	.34	11.94	871	1,006	533	67.0	257
	5	9	252	15.0	15.8	.22	11.85	288	386	250	16.2	72.0
	6	28	351	21.0	15.7	.31	11.84	843	954	484	65.6	247
	7	84	681	44.2	14.4	1.38	11.53	1,220	1,413	4,294	185	722
	8	28	343	21.0	15.3	.40	11.92	798	1,033	626	61.3	254
	9	0	155	9.8	14.8	.83	11.11	6,650	149	590	235	18.6
4	1	0	101	6.3	15.0	.57	11.99	1,197	79	259	27.0	5.91
	2	28	381	22.3	16.1	.34	11.74	953	804	577	79.1	222
	3	56	510	30.9	15.5	.33	11.94	1,353	1,962	762	153	736
	4	28	348	21.0	15.6	.32	11.90	820	1,018	509	63.5	260
	5	9	253	15.0	15.9	.21	11.69	310	374	244	17.7	70.9
	6	28	350	21.0	15.6	.31	11.76	820	955	488	64.3	249
	7	84	691	45.2	14.3	1.52	11.66	1,330	1,430	4,725	205	731
	8	28	337	20.6	15.4	.42	11.87	865	1,033	642	65.3	259
	9	0	157	10.0	14.6	1.04	11.27	6,513	170	733	228	19.8

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	36.1	g/bhp-hr
BSHC	3.98	g/bhp-hr
$BSNO_2$	10.1	g/bhp-hr
BSFC	.737	lb/bhp-hr

==Test Conditions==
Barometer 747.4 mmHg
Humidity 41.7 grains H_2O/lb dry air
Inlet air temperature 74° F

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* NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE C-3. - Baseline emissions (9-mode cycle) for gasoline engine adjusted to manufacturer's specifications (no EGR, no manifold air injection, and no catalysts)-Continued

[Test No. 3--31 engine hours]

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x*, ppm	grams/hr		
						CO	CO_2			CO	HC	NO_2 *
1	1	0	84	5.2	15.2	0.38	11.65	2,081	76	150	40.1	4.86
	2	28	372	22.2	15.8	.35	11.70	1,151	840	589	95.3	231
	3	56	497	30.2	15.4	.35	11.88	1,417	1,827	785	157	672
	4	28	335	20.2	15.6	.33	11.90	974	934	501	72.4	230
	5	9	228	13.8	15.5	.33	11.89	398	324	344	20.3	54.9
	6	28	348	20.8	15.8	.34	11.83	930	802	534	71.6	205
	7	84	679	44.6	14.2	1.70	11.51	1,416	1,298	5,204	215	653
	8	28	331	20.2	15.4	.44	11.93	974	1,008	651	71.6	246
	9	0	148	9.8	14.2	1.13	11.04	7,747	132	782	266	15.0
2	1	0	84	5.2	15.2	.38	11.65	2,081	76	150	40.1	4.86
	2	28	357	21.0	16.0	.28	11.70	1,107	727	449	87.2	190
	3	56	507	30.7	15.5	.33	11.89	1,394	1,943	759	157	727
	4	28	340	20.5	15.6	.35	11.90	907	972	535	68.4	243
	5	9	238	14.2	15.8	.26	11.92	332	363	281	17.5	63.5
	6	28	346	20.8	15.6	.32	11.93	885	972	489	67.7	247
	7	84	680	44.2	14.4	1.53	11.53	1,306	1,394	4,697	199	704
	8	28	329	20.0	15.5	.44	11.89	930	1,028	648	67.9	249
	9	0	151	9.8	14.4	1.10	11.07	8,588	132	761	293	14.9
3	1	0	97	6.0	15.1	.52	12.04	1,417	76	227	30.3	5.40
	2	28	341	20.0	16.1	.38	11.71	930	574	571	69.3	142
	3	56	498	30.0	15.6	.33	11.90	1,417	1,953	742	156	713
	4	28	338	20.3	15.7	.37	11.82	841	973	560	63.1	242
	5	9	239	14.2	15.8	.28	11.92	310	367	300	16.3	64.1
	6	28	341	20.3	15.8	.33	11.83	830	353	508	62.4	88.1
	7	84	680	44.1	14.4	1.47	11.53	1,284	1,394	453	196	706
	8	28	330	20.0	15.5	.40	11.89	874	1,009	598	64.0	246
	9	0	147	9.2	15.0	.89	10.47	9,407	143	611	319	16.1
4	1	0	97	6.0	15.1	.52	12.04	1,417	76	227	30.3	5.40
	2	28	347	20.4	16.0	.33	11.62	1,018	631	520	78.2	161
	3	56	497	30.0	15.6	.34	11.89	1,350	1,943	761	148	710
	4	28	334	20.0	15.7	.34	11.91	775	973	510	57.0	238
	5	9	242	14.2	16.0	.24	11.94	266	363	254	14.0	63.7
	6	28	347	20.6	15.8	.33	11.77	841	936	505	64.5	239
	7	84	682	44.0	14.5	1.35	11.59	1,195	1,414	4,162	183	718
	8	28	331	20.0	15.5	.40	11.89	885	1,029	598	64.8	250
	9	0	149	9.5	14.7	.99	11.07	8,023	151	672	269	16.8

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	35.5	g/bhp-hr
BSHC	4.31	g/bhp-hr
$BSNO_2$	9.48	g/bhp-hr
BSFC	.713	lb/bhp-hr

==Test Conditions==
Barometer 747.5 mmHg
Humidity 41.7 grains H_2O/lb dry air
Inlet air temperature 74° F

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* NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE C-4. - Baseline emissions (9-mode cycle) for gasoline engine equipped with emission controls (standard ignition timing, manifold air injection, two platinum pelleted type catalysts, and 10 pct EGR)

[Test No. 1--82 engine hours and 17 hours on emission controls]

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2 *
1	1	0	123	6.0	19.6	0.02	10.01	157	33	9.05	4.25	3.00
	2	28	487	25.2	18.3	.03	10.74	117	191	62.4	12.4	67.1
	3	56	634	35.0	17.1	.02	11.43	56	620	40.6	7.76	286
	4	28	478	24.0	18.9	.008	10.35	36	270	17.8	3.78	94.2
	5	9	362	16.6	20.8	.006	9.43	44	151	9.23	3.51	40.0
	6	28	460	23.8	18.3	.01	10.67	43	268	24.5	4.34	89.7
	7	84	777	46.0	15.9	.03	12.26	60	1,404	109	10.2	791
	8	28	439	22.8	18.3	.009	10.67	17	301	16.8	1.65	96.9
	9	0	240	10.4	22.1	.006	8.88	43	101	6.86	2.28	17.9
2	1	0	123	6.0	19.6	0.02	10.01	157	33	9.05	4.25	3.00
	2	28	473	24.2	18.5	.009	10.65	47	232	19.2	4.84	79.4
	3	56	650	35.8	17.2	.01	11.44	23	633	27.3	3.26	298
	4	28	478	24.0	18.9	.007	10.35	24	269	14.1	2.52	94.0
	5	9	360	16.5	20.8	.005	9.47	30	133	8.12	2.37	34.8
	6	28	481	24.0	19.0	.007	10.36	30	258	15.1	3.15	89.9
	7	84	786	46.0	16.1	.02	12.20	36	1,461	82.2	6.14	828
	8	28	454	22.6	19.1	.006	10.24	15	265	12.0	1.50	87.9
	9	0	239	11.0	20.7	.005	10.86	24	99	5.06	1.10	15.1
3	1	0	108	5.2	19.7	0.007	9.95	34	60	3.20	0.805	4.73
	2	28	481	24.8	18.4	.01	10.68	35	261	20.4	3.68	91.2
	3	56	637	35.2	17.1	.02	11.41	24	537	47.7	3.35	249
	4	28	450	23.4	18.2	.007	10.77	15	306	15.2	1.48	100
	5	9	366	16.8	20.8	.005	9.47	22	136	7.98	1.77	36.3
	6	28	459	23.7	18.4	.008	10.66	21	296	16.6	2.12	99.0
	7	84	787	46.2	16.0	.08	12.08	38	1,141	291	6.54	652
	8	28	469	23.4	19.0	.006	10.19	13	275	13.3	1.35	94.9
	9	0	244	11.2	20.7	.005	10.89	24	97	4.79	1.12	14.9
4	1	0	108	5.2	19.7	0.007	9.95	34	60	3.20	0.805	4.73
	2	28	444	22.8	18.5	.008	10.65	29	244	16.5	2.81	78.5
	3	56	633	35.0	17.1	.02	11.48	23	526	46.6	3.17	241
	4	28	479	24.0	19.0	.006	10.36	17	291	13.8	1.79	102
	5	9	354	16.2	20.9	.004	9.44	21	128	6.87	1.63	33.0
	6	28	445	23.2	18.2	.008	10.70	23	311	16.5	2.26	102
	7	84	786	45.2	16.4	.02	11.90	30	1,491	57.8	5.16	852
	8	28	464	23.2	19.0	.006	10.32	13	280	12.0	1.32	94.6
	9	0	228	10.5	20.7	.005	10.86	26	97	4.35	1.14	14.2

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	1.15	g/bhp-hr
BSHC	.11	g/bhp-hr
$BSNO_2$	5.92	g/bhp-hr
BSFC	.795	lb/bhp-hr

==Test Conditions==

Barometer	740.5 mmHg
Humidity	54.5 grains H_2O/lb dry air
Inlet air temperature	79° F

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* NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE C-4. - Baseline emissions (9-mode cycle) for gasoline engine equipped with emission controls (standard ignition timing, manifold air injection, two platinum pelleted type catalysts, and 10 pct EGR)-Continued

[Test No. 2--83 engine hours and 18 hours on emission controls]

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2*
1	1	0	114	5.5	19.8	0.02	9.74	128	28	8.35	3.27	2.34
	2	28	496	25.2	18.7	.02	10.34	122	166	54.0	13.4	60.8
	3	56	641	35.0	17.3	.01	11.25	58	625	38.5	8.17	293
	4	28	471	23.4	19.1	.007	10.20	44	275	15.0	4.58	94.9
	5	9	357	16.4	20.8	.005	9.28	43	137	8.24	3.45	36.4
	6	28	464	23.8	18.5	.01	10.54	43	264	21.1	4.40	89.6
	7	84	782	46.2	15.9	.03	12.14	58	1,384	99.6	9.98	791
	8	28	456	22.8	19.0	.006	10.19	26	264	13.3	2.64	88.8
	9	0	242	10.3	22.5	.006	8.69	91	97	6.56	4.89	17.3
2	1	0	114	5.5	19.8	0.02	9.74	128	28	8.35	3.27	2.34
	2	28	459	23.6	18.5	.001	10.54	44	249	19.7	4.46	83.8
	3	56	652	35.8	17.2	.009	11.19	30	651	27.1	4.35	313
	4	28	469	23.2	19.2	.006	10.16	24	258	11.5	2.48	88.7
	5	9	368	16.8	20.9	.004	9.35	46	134	7.04	3.75	36.4
	6	28	457	23.5	18.5	.008	10.54	33	282	16.3	3.33	94.6
	7	84	784	45.8	16.1	.02	11.95	37	1,447	74.9	6.42	834
	8	28	436	22.5	18.4	.006	10.57	13	315	11.9	1.25	101
	9	0	252	11.0	21.9	.004	8.83	29	106	4.90	1.64	19.8
3	1	0	119	5.7	19.8	0.006	9.78	40	52	3.28	1.06	4.54
	2	28	456	23.7	18.2	.001	10.70	38	272	20.0	3.81	90.5
	3	56	629	34.7	17.1	.01	11.22	24	534	40.5	3.36	248
	4	28	450	23.3	18.3	.007	10.53	20	316	15.1	2.00	105
	5	9	357	16.2	21.0	.004	9.29	30	135	6.83	2.37	35.3
	6	28	459	24.0	18.1	.008	10.66	30	320	17.2	3.06	108
	7	84	780	46.0	16.0	.02	11.97	37	1,405	80.8	6.43	811
	8	28	429	22.2	18.3	.006	10.57	15	307	11.7	1.43	96.9
	9	0	257	11.1	22.2	.005	8.79	23	101	5.29	1.32	19.3
4	1	0	119	5.7	19.8	0.006	9.78	40	52	3.28	1.06	4.54
	2	28	456	24.0	18.0	.01	10.91	46	265	26.3	4.58	87.5
	3	56	637	35.4	17.0	.02	11.34	24	568	49.0	3.39	267
	4	28	444	23.0	18.3	.007	10.57	16	315	14.5	1.58	103
	5	9	353	16.0	21.0	.004	9.25	41	128	7.06	3.21	33.3
	6	28	440	22.7	18.4	.008	10.57	24	297	15.0	2.34	95.9
	7	84	772	45.2	16.1	.04	11.95	32	1,223	139	5.47	694
	8	28	459	23.4	18.6	.006	10.59	17	307	12.5	1.70	102
	9	0	254	11.0	22.1	.004	8.82	23	106	5.01	1.30	19.8

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	0.95	g/bhp-hr
BSHC	.12	g/bhp-hr
$BSNO_2$	6.04	g/bhp-hr
BSFC	.793	lb/bhp-hr

==Test Conditions==

Barometer 740.5 mmHg
Humidity 54.5 grains H_2O/lb dry air
Inlet air temperature 79° F

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*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE C-4. - Baseline emissions (9-mode cycle) for gasoline engine equipped with emission controls (standard ignition timing, manifold air injection, two platinum pelleted type catalysts, and 10 pct EGR)-Continued

[Test No. 3--105 engine hours and 40 hours on emission controls]

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2 *
1	1	0	128	6.0	20.4	0.09	9.61	1,229	38	49.7	34.0	3.54
	2	28	502	25.0	19.1	.07	10.36	378	149	144	41.0	53.8
	3	56	642	34.4	17.7	.01	11.24	71	505	31.2	9.84	232
	4	28	484	24.0	19.2	.01	10.37	53	249	21.4	5.56	86.7
	5	9	379	17.0	21.3	.006	9.45	65	136	10.5	5.29	36.8
	6	28	467	23.3	19.0	.01	10.58	53	228	21.1	5.29	75.6
	7	84	790	43.5	17.2	.02	11.53	77	1,353	66.6	13.1	767
	8	28	435	21.8	19.0	.02	10.50	25	287	30.3	2.35	89.6
	9	0	255	10.7	22.9	.006	8.76	84	118	7.18	4.65	21.7
2	1	0	128	6.0	20.4	0.09	9.61	1,229	38	49.7	34.0	3.54
	2	28	504	23.0	20.9	.008	9.64	118	92	17.3	12.7	33.1
	3	56	617	33.2	17.6	.02	11.30	41	508	39.9	5.44	224
	4	28	476	23.2	19.5	.006	10.22	31	288	13.5	3.19	77.9
	5	9	373	16.5	21.6	.005	9.31	41	126	8.00	3.29	33.6
	6	28	468	23.2	19.2	.008	10.41	38	234	15.5	3.84	78.6
	7	84	768	42.0	17.3	.02	11.45	54	1,297	49.3	8.97	715
	8	28	470	22.8	19.6	.006	10.19	22	261	12.0	2.23	87.8
	9	0	258	10.8	22.9	.005	8.80	68	114	5.77	3.78	21.1
3	1	0	122	5.8	20.0	0.007	10.00	49	57	3.89	1.29	4.95
	2	28	511	25.2	19.3	.009	10.41	76	210	20.6	8.33	76.5
	3	56	624	33.0	17.9	.01	11.02	31	485	37.3	4.20	218
	4	28	478	24.0	18.9	.007	10.53	22	287	15.2	2.27	98.4
	5	9	365	16.0	21.8	.004	9.23	46	126	7.10	3.61	32.9
	6	28	460	22.8	19.2	.008	10.37	27	247	15.1	2.69	81.6
	7	84	772	44.5	16.4	.09	12.01	43	998	297	7.17	553
	8	28	475	23.0	19.6	.006	10.19	21	248	12.1	2.15	84.3
	9	0	262	10.9	23.0	.005	8.76	47	106	6.17	2.65	19.8
4	1	0	122	5.8	20.0	0.007	10.00	49	57	3.89	1.29	4.95
	2	28	461	23.0	19.0	.008	10.54	35	184	16.0	3.46	60.5
	3	56	645	34.3	17.8	.007	11.19	25	553	20.3	3.47	255
	4	28	465	22.5	19.7	.006	10.19	24	233	11.5	2.40	77.5
	5	9	360	15.8	21.8	.004	9.25	41	128	6.72	3.18	32.9
	6	28	481	23.2	19.8	.006	10.16	37	222	11.9	3.83	76.5
	7	84	770	42.0	17.3	.01	11.39	35	1,190	47.5	5.85	660
	8	28	475	23.0	19.6	.005	10.19	24	247	10.8	2.46	84.0
	9	0	261	10.8	23.1	.005	8.67	59	108	5.65	3.33	20.3

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	1.19	g/bhp-hr
BSHC	.26	g/bhp-hr
$BSNO_2$	5.13	g/bhp-hr
BSFC	.775	lb/bhp-hr

==Test Conditions==

Barometer 739.0 mmHg
Humidity 53.9 grains H_2O/lb dry air
Inlet air temperature 77° F

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* NO_x data are corrected to 75 grains H_2O/lb humidity.

APPENDIX D.--EMISSION DATA FROM THE DURABILITY TESTS OF THE GASOLINE ENGINE WITH EXHAUST SAMPLED UPSTREAM OF CATALYTIC CONVERTERS

TABLE D-1. - Emissions (upstream of catalysts) for gasoline engine at 121 engine hours and 56 hours on emission controls

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2*
1	1	0	110	5.3	19.8	0.51	9.33	947	47	248	22.9	3.78
	2	28	518	25.5	19.3	.19	9.90	721	172	436	82.1	65.0
	3	56	630	34.2	17.4	.23	10.98	338	533	646	46.6	244
	4	28	447	22.2	19.1	.16	10.02	372	194	323	36.7	63.4
	5	9	341	15.3	21.3	.16	9.02	811	96	248	60.8	24.0
	6	28	481	23.8	19.2	.16	10.02	455	211	346	48.0	73.9
	7	84	800	44.8	16.9	.38	11.20	257	1,153	1,350	45.0	671
	8	28	437	21.8	19.1	.16	10.08	256	218	315	24.6	69.8
	9	0	239	10.1	22.6	.22	8.39	676	83	235	35.7	14.6
2	1	0	110	5.3	19.8	0.51	9.33	947	47	248	22.9	3.78
	2	28	488	24.3	19.1	.21	10.16	676	176	442	71.4	61.6
	3	56	660	35.7	17.5	.20	10.99	259	543	573	37.4	260
	4	28	462	23.0	19.1	.16	10.09	270	218	333	27.4	73.7
	5	9	336	15.0	21.4	.15	8.98	452	101	219	33.5	24.9
	6	28	462	22.8	19.3	.16	10.06	361	203	331	36.4	68.0
	7	84	792	43.8	17.1	.28	11.14	183	1,171	999	31.8	675
	8	28	424	21.1	19.1	.16	10.08	169	211	306	15.8	65.2
	9	0	231	9.9	22.3	.20	8.52	857	84	208	43.7	14.2
3	1	0	96	4.7	19.4	0.45	9.60	518	47	192	10.9	3.29
	2	28	473	23.3	19.3	.17	10.10	669	173	354	68.4	58.6
	3	56	638	34.3	17.6	.17	10.92	282	533	480	39.5	248
	4	28	450	22.4	19.1	.16	10.05	259	222	325	25.7	73.0
	5	9	336	15.0	21.4	.16	8.89	451	103	248	33.7	25.5
	6	28	462	23.0	19.1	.19	10.05	372	203	388	37.8	68.4
	7	84	774	45.0	16.2	.46	11.52	225	1,032	1,580	38.3	583
	8	28	414	21.2	18.5	.21	10.42	158	243	377	14.3	73.0
	9	0	227	9.7	22.4	.21	8.48	676	87	214	34.0	14.6
4	1	0	96	4.7	19.4	0.45	9.60	518	47	192	10.9	3.29
	2	28	478	23.8	19.1	.22	10.16	541	182	452	56.0	62.5
	3	56	647	35.0	17.5	.21	10.99	228	562	611	32.2	264
	4	28	439	21.8	19.2	.16	10.03	230	211	317	22.3	67.7
	5	9	331	14.8	21.4	.15	8.98	473	98	229	34.6	23.8
	6	28	461	23.0	19.1	.17	10.12	366	205	349	37.0	68.8
	7	84	806	45.0	16.9	.35	11.32	214	1,250	1,220	37.4	725
	8	28	432	21.5	19.1	.16	10.05	192	212	312	18.3	67.2
	9	0	221	9.4	22.5	.20	8.39	789	82	200	38.8	13.3

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	16.2	g/bhp-hr
BSHC	1.21	g/bhp-hr
$BSNO_2$	5.10	g/bhp-hr
BSFC	.763	lb/bhp-hr

==Test Conditions==

Barometer	753.8 mmHg
Humidity	41.3 grains H_2O/lb dry air
Inlet air temperature	74° F

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* NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE D-2. - Emissions (upstream of catalysts) for gasoline engine at 269 engine hours and 204 hours on emission control

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2*
1	1	0	121	5.8	19.9	0.56	9.23	645	44	303	17.2	3.90
	2	28	472	23.5	19.1	.32	9.91	1,153	196	675	119	67.0
	3	56	610	33.0	17.5	.38	10.80	753	669	1,030	100	296
	4	28	462	22.8	19.3	.22	9.86	330	248	447	33.8	84.3
	5	9	353	15.8	21.4	.15	8.98	871	117	229	67.7	30.2
	6	28	446	22.7	18.6	.34	10.30	800	264	663	76.8	84.2
	7	84	784	45.0	16.4	.73	11.14	287	1,319	2,545	49.2	751
	8	28	451	22.7	18.9	.22	10.15	118	306	433	11.7	101
	9	0	257	11.0	22.3	.26	8.17	3,295	91	295	188	17.2
2	1	0	121	5.8	19.9	0.56	9.23	645	44	303	17.2	3.90
	2	28	443	22.3	18.9	.32	10.11	753	256	630	72.5	81.8
	3	56	598	32.7	17.3	.42	10.86	377	731	1,110	49.4	318
	4	28	452	22.3	19.3	.16	9.96	494	284	326	49.1	93.7
	5	9	325	14.4	21.6	.16	8.90	447	126	225	32.1	29.9
	6	28	438	22.2	18.7	.29	10.10	699	304	560	67.3	97.1
	7	84	771	44.0	16.5	.51	11.25	301	1,361	1,760	50.9	765
	8	28	436	22.0	18.8	.25	10.00	188	318	495	18.3	103
	9	0	251	11.0	21.8	.22	8.47	2,071	106	248	116	18.7
3	1	0	117	5.7	19.5	0.44	9.37	438	47	235	11.5	4.12
	2	28	434	22.0	18.7	.34	10.14	683	271	653	64.6	85.0
	3	56	585	32.0	17.3	.42	10.89	400	735	1,080	51.1	312
	4	28	449	22.2	19.2	.19	9.96	400	273	378	39.5	89.6
	5	9	358	16.0	21.4	.15	9.02	424	117	232	33.4	30.7
	6	28	425	21.3	18.9	.25	9.98	683	283	478	64.1	88.0
	7	84	772	44.2	16.5	.58	11.13	297	1,422	1,990	50.7	807
	8	28	433	21.3	19.3	.16	9.83	212	283	317	20.5	90.7
	9	0	256	11.0	22.2	.22	8.38	1,059	97	254	60.7	18.4
4	1	0	117	5.7	19.5	0.44	9.37	438	47	235	11.5	4.12
	2	28	453	22.3	19.3	.22	9.76	619	237	441	62.4	79.3
	3	56	587	32.0	17.4	.38	10.68	377	734	1,010	49.3	319
	4	28	459	22.7	19.2	.18	9.82	353	306	374	36.2	104
	5	9	336	15.0	21.4	.15	8.86	541	117	235	40.6	29.2
	6	28	448	22.0	19.4	.16	9.72	588	263	329	59.0	87.5
	7	84	764	43.8	16.4	.57	11.05	254	1,374	1,980	43.3	778
	8	28	436	21.5	19.3	.17	9.75	188	269	340	18.4	87.6
	9	0	256	11.0	22.3	.22	8.34	1,036	94	256	59.7	18.0

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	23.6	g/bhp-hr
BSHC	1.79	g/bhp-hr
$BSNO_2$	6.20	g/bhp-hr
BSFC	.756	lb/bhp-hr

==Test Conditions==

Barometer 742.6 mmHg
Humidity 53.0 grains H_2O/lb dry air
Inlet air temperature 80° F

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* NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE D-3. - Emissions (upstream of catalysts) for gasoline engine at 389 engine hours and 325 hours on emission controls

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2*
1	1	0	112	5.2	20.5	0.56	8.85	1,000	44	282	24.8	3.65
	2	28	483	23.8	19.3	.35	9.60	1,023	191	763	110	68.3
	3	56	623	33.8	17.4	.47	10.5	767	587	1,322	106	270
	4	28	465	22.8	19.4	.17	9.66	616	246	362	64.4	85.4
	5	9	344	15.4	21.3	.15	8.89	581	105	226	44.6	26.7
	6	28	447	22.4	19.0	.32	9.79	598	246	654	59.7	81.4
	7	84	779	45.0	16.3	.78	11.0	604	1,201	2,715	104	689
	8	28	429	21.7	18.8	.22	10.0	400	283	434	38.2	89.9
	9	0	245	10.2	23.0	.25	8.01	1,348	88	276	74.3	16.1
2	1	0	112	5.2	20.5	.56	8.85	1,000	44	282	24.8	3.65
	2	28	440	22.2	18.8	.40	9.89	767	228	794	74.5	73.6
	3	56	615	33.7	17.3	.48	10.67	512	611	1,326	69.9	277
	4	28	457	22.4	19.4	.17	9.71	442	263	355	45.2	89.5
	5	9	336	15.0	21.4	.14	8.89	395	116	207	29.7	28.8
	6	28	440	22.0	19.0	.32	9.79	512	269	625	50.3	87.8
	7	84	776	44.4	16.5	.60	11.0	511	1,294	2,103	88.3	743
	8	28	443	22.0	19.1	.17	9.85	372	288	343	36.9	94.9
	9	0	242	10.2	22.7	.21	8.30	581	92	230	31.4	16.5
3	1	0	104	5.0	19.7	.47	9.29	535	46	220	12.4	3.52
	2	28	461	23.0	19.0	.32	9.90	767	229	646	77.7	77.0
	3	56	597	33.0	17.1	.49	10.7	488	619	1,315	64.9	273
	4	28	422	21.8	18.3	.35	10.2	384	329	663	36.0	102
	5	9	338	15.1	21.4	.14	8.89	460	115	209	34.7	28.8
	6	28	427	21.8	18.6	.35	10.1	488	300	668	46.1	94.0
	7	84	774	44.8	16.3	.72	11.0	442	1,247	2,504	76.5	717
	8	28	440	21.8	19.2	.17	9.75	349	273	344	34.7	90.0
	9	0	239	10.1	22.7	.20	8.30	395	96	218	21.2	17.2
4	1	0	104	5.0	19.7	.47	9.29	535	46	220	12.4	3.52
	2	28	440	22.2	18.8	.39	9.89	651	239	761	63.4	77.1
	3	56	597	32.7	17.2	.45	10.6	512	620	1,224	68.3	274
	4	28	436	22.0	18.8	.29	9.98	414	281	563	40.1	90.3
	5	9	350	15.7	21.3	.14	8.98	465	112	215	36.1	29.0
	6	28	432	22.0	18.6	.33	10.0	465	275	645	44.6	87.8
	7	84	772	44.5	16.3	.69	11.0	488	1,247	2,400	84.0	713
	8	28	444	22.1	19.1	.19	9.85	392	281	380	39.0	92.9
	9	0	238	10.1	22.6	.21	8.34	465	97	227	24.8	17.2

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	27.6	g/bhp-hr
BSHC	1.75	g/bhp-hr
$BSNO_2$	5.68	g/bhp-hr
BSFC	.751	lb/bhp-hr

==Test Conditions==

Barometer 737 mmHg
Humidity 58.6 grains H_2O/lb dry air
Inlet air temperature 75° F

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* NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE D-4. - Emissions (upstream of catalysts) for gasoline engine at 458 engine hours and 394 hours on emission controls

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2*
1	1	0	120	5.8	19.7	0.60	9.19	1,317	46	320	34.9	4.07
	2	28	500	25.0	19.0	.41	9.74	1,223	201	924	135	73.7
	3	56	630	34.2	17.4	.42	10.68	1,082	708	1,172	150	326
	4	28	457	22.5	19.3	.20	9.75	847	248	408	86.1	83.9
	5	9	357	16.0	21.3	.15	8.89	917	117	249	72.8	30.7
	6	28	463	23.0	19.1	.27	9.85	823	248	558	84.1	84.3
	7	84	788	45.0	16.5	.81	10.83	706	1,306	2,868	123	756
	8	28	440	22.0	19.0	.20	9.95	635	266	391	62.1	86.3
	9	0	259	11.2	22.1	.26	8.47	988	105	298	56.9	20.1
2	1	0	120	5.8	19.7	.60	9.19	1,317	46	320	34.9	4.07
	2	28	475	23.2	19.5	.30	9.67	1,082	240	629	113	83.2
	3	56	595	32.2	17.5	.45	10.58	917	697	1,207	120	304
	4	28	459	22.6	19.3	.17	9.76	729	272	355	74.7	92.7
	5	9	341	15.2	21.4	.15	8.79	706	117	239	54.0	29.6
	6	28	457	22.6	19.2	.30	9.65	870	270	614	88.9	91.8
	7	84	784	44.8	16.5	.80	10.72	706	1,341	2,823	124	781
	8	28	440	21.8	19.2	.17	9.75	541	284	343	53.6	93.4
	9	0	258	11.1	22.2	.24	8.47	682	101	276	39.1	19.2
3	1	0	117	5.7	19.4	.50	9.46	564	46	259	14.6	3.96
	2	28	459	22.8	19.1	.34	9.75	870	239	703	88.4	80.8
	3	56	596	32.4	17.4	.52	10.57	894	710	1,373	118	310
	4	28	440	22.0	19.0	.22	9.95	635	280	426	62.0	90.7
	5	9	349	15.6	21.3	.15	8.89	776	119	243	60.2	30.7
	6	28	428	21.8	18.7	.43	9.92	729	274	827	69.1	86.3
	7	84	787	45.0	16.5	.78	10.83	659	1,371	2,753	115	796
	8	28	443	22.0	19.2	.18	9.86	564	284	360	55.8	93.2
	9	0	258	11.1	22.2	.23	8.47	470	102	266	27.1	19.4
4	1	0	117	5.7	19.4	.50	9.46	564	46	259	14.6	3.96
	2	28	439	22.2	18.8	.46	9.83	611	279	902	59.4	90.0
	3	56	606	33.0	17.3	.52	10.57	800	717	1,400	107	319
	4	28	458	22.5	19.4	.17	9.76	682	279	354	69.6	94.5
	5	9	352	15.7	21.4	.15	8.89	612	114	231	47.9	29.6
	6	28	443	22.0	19.1	.34	9.74	729	273	680	71.6	89.0
	7	84	778	44.7	16.4	.81	10.82	706	1,371	2,849	122	788
	8	28	441	21.7	19.3	.17	9.76	541	268	342	53.3	87.8
	9	0	257	11.0	22.4	.22	8.38	494	104	256	28.5	19.8

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	29.8	g/bhp-hr
BSHC	2.50	g/bhp-hr
$BSNO_2$	6.22	g/bhp-hr
BSFC	.764	lb/bhp-hr

==Test Conditions==

Barometer 742.5 mmHg
Humidity 70.3 grains H_2O/lb dry air
Inlet air temperature 78° F

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* NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE D-5. - Emissions (upstream of catalysts) for gasoline engine at 563 engine hours and 498 hours on emission controls

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2*
1	1	0	110	5.2	20.1	0.50	9.21	1,163	50	242	27.9	4.01
	2	28	461	22.3	19.7	.23	9.58	1,841	249	481	186	83.8
	3	56	590	31.2	17.9	.34	10.50	1,453	863	885	187	369
	4	28	433	21.4	19.2	.19	9.86	1,247	346	365	119	110
	5	9	315	14.0	21.5	.17	8.80	957	160	245	67.0	37.2
	6	28	442	21.3	19.7	.17	9.66	1,381	310	336	134	99.8
	7	84	767	42.2	17.2	.66	10.63	1,284	1,517	2,231	215	845
	8	28	422	20.8	19.3	.17	9.75	969	373	326	91.2	116
	9	0	269	11.5	22.4	.26	8.38	993	150	309	59.3	29.7
2	1	0	110	5.2	20.1	.50	9.21	1,163	50	242	27.9	4.01
	2	28	417	20.0	19.9	.17	9.62	1,574	282	316	143	85.4
	3	56	610	32.0	18.1	.19	10.52	1,066	981	510	143	438
	4	28	434	21.2	19.5	.22	9.67	993	356	422	95.7	114
	5	9	324	14.3	21.7	.16	8.71	799	180	240	57.9	43.4
	6	28	439	21.2	19.7	.17	9.64	1,114	352	336	107	113
	7	84	747	41.2	17.1	.63	10.59	1,090	1,543	2,105	180	845
	8	28	424	20.8	19.4	.17	9.76	799	404	327	75.3	127
	9	0	263	11.3	22.3	.22	8.38	606	156	263	35.9	30.7
3	1	0	109	5.2	19.9	.44	9.39	654	54	213	15.6	4.33
	2	28	425	21.0	19.2	.34	9.75	1,187	347	646	111	107
	3	56	594	31.2	18.0	.21	10.51	1,066	1,025	567	139	445
	4	28	433	21.2	19.4	.17	9.76	920	378	332	88.3	120
	5	9	320	14.2	21.5	.15	8.80	678	188	224	48.4	44.7
	6	28	432	21.0	19.6	.17	9.67	1,163	368	332	111	117
	7	84	763	42.0	17.2	.59	10.66	1,017	1,673	1,992	171	932
	8	28	422	20.8	19.3	.18	9.86	751	404	357	70.0	125
	9	0	248	10.7	22.2	.22	8.47	606	160	246	33.6	29.6
4	1	0	109	5.2	19.9	.44	9.39	654	54	213	15.6	4.33
	2	28	429	20.8	19.6	.17	9.67	1,138	326	329	108	102
	3	56	589	31.5	17.7	.17	10.60	1,344	1,027	449	176	447
	4	28	425	20.8	19.4	.18	9.76	920	394	343	86.5	123
	5	9	317	14.0	21.6	.15	8.80	678	178	221	47.7	41.6
	6	28	436	21.2	19.5	.17	9.77	1,114	378	331	106	120
	7	84	765	42.0	17.2	.51	10.70	993	1,799	1,727	167	1,007
	8	28	412	20.3	19.3	.17	9.86	678	404	316	61.8	122
	9	0	242	10.4	22.3	.21	8.47	557	163	230	30.1	29.3

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	19.4	g/bhp-hr
BSHC	3.28	g/bhp-hr
$BSNO_2$	7.83	g/bhp-hr
BSFC	.719	lb/bhp-hr

==Test Conditions==

Barometer 746 mmHg
Humidity 67.7 grains H_2O/lb dry air
Inlet air temperature 77° F

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* NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE D-6. - Emissions (upstream of catalysts) for gasoline engine at 691 engine hours and 635 hours on emission controls

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2*
1	1	0	116	6.7	16.4	1.29	10.60	474	37	664	12.1	3.09
	2	28	436	22.3	18.6	.57	9.71	1,557	221	1,125	151	71.0
	3	56	606	32.5	17.6	.24	10.70	971	720	651	130	319
	4	28	421	21	19.1	.20	9.74	880	290	380	83.6	91.6
	5	9	303	14.0	20.6	.18	9.04	519	146	251	35.5	33.1
	6	28	442	21.8	19.3	.19	9.75	948	277	377	93.4	90.5
	7	84	772	42.5	17.2	.53	10.67	813	1,470	1,844	139	834
	8	28	413	20.8	18.9	.21	9.94	643	332	387	59.4	102
	9	0	242	11.2	20.6	.27	9.04	158	127	300	8.60	22.9
2	1	0	116	6.7	16.4	1.29	10.60	474	37	664	12.1	3.09
	2	28	431	21.5	19.0	.29	9.74	1,083	292	560	104	93.4
	3	56	602	32.0	17.8	.24	10.60	677	801	649	90.1	354
	4	28	423	21.0	19.2	.19	9.75	722	326	364	68.7	103
	5	9	287	13.2	20.8	.18	9.05	361	170	237	23.3	36.4
	6	28	432	21.2	19.4	.18	9.76	790	310	350	75.8	99.0
	7	84	771	42.5	17.1	.51	10.78	677	1,640	1,740	115	925
	8	28	406	20.2	19.1	.20	9.74	587	359	367	53.8	109
	9	0	245	11.2	20.9	.24	8.96	135	134	264	7.45	24.6
3	1	0	108	6.2	16.3	.55	11.38	147	46	261	3.46	3.60
	2	28	426	21.0	19.3	.26	9.56	1,061	294	507	102	93.8
	3	56	594	31.5	17.9	.23	10.50	666	824	622	88.1	362
	4	28	426	21.0	19.3	.20	9.65	722	335	385	69.3	107
	5	9	287	13.2	20.8	.19	9.05	384	177	249	24.8	37.9
	6	28	418	20.5	19.4	.19	9.66	813	319	359	76.1	99.3
	7	84	757	41.5	17.2	.47	10.67	767	1,663	1,600	129	927
	8	28	406	20.2	19.1	.20	9.74	632	354	367	57.9	108
	9	0	246	11.2	21.0	.24	8.88	135	145	266	7.51	26.8
4	1	0	108	6.2	16.3	.55	11.38	147	46	261	3.46	3.60
	2	28	425	21.0	19.3	.18	9.86	937	288	343	88.1	89.9
	3	56	596	31.5	17.9	.22	10.50	700	813	598	92.6	357
	4	28	410	20.2	19.3	.18	9.75	677	337	334	62.0	103
	5	9	294	13.5	20.8	.19	9.05	384	181	255	25.3	39.6
	6	28	418	20.5	19.4	.18	9.76	790	328	339	73.3	101
	7	84	756	41.5	17.2	.49	10.67	722	1,617	1,659	121	900
	8	28	417	20.8	19.0	.20	9.85	576	376	374	53.8	117
	9	0	246	11.2	21.0	.24	8.88	158	143	266	8.79	26.5

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	20.7	g/bhp-hr
BSHC	2.10	g/bhp-hr
$BSNO_2$	7.09	g/bhp-hr
BSFC	.730	lb/bhp-hr

==Test Conditions==

Barometer 739.4 mmHg
Humidity 70.2 grains H_2O/lb dry air
Inlet air temperature 76° F

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* NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE D-7. - Emissions (upstream of catalysts) for gasoline engine at 796 engine hours and 731 hours on emission controls

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2*
1	1	0	100	6.8	13.8	4.22	8.95	5,274	39	1,923	119	2.89
	2	28	383	21.0	17.3	.88	10.24	1,332	313	1,507	113	87.8
	3	56	602	33.2	17.1	.25	11.00	514	607	671	69.5	269
	4	28	439	22.5	18.5	.22	10.12	750	263	427	73.5	85.5
	5	9	308	15.3	19.2	.55	9.55	264	132	762	18.1	30.0
	6	28	456	24.0	18.0	.43	10.29	777	277	875	78.3	92.6
	7	84	752	43.0	16.5	.52	10.94	479	1,316	1,788	81.1	741
	8	28	417	22.5	17.5	.56	10.37	396	287	1,056	36.8	88.7
	9	0	227	11.2	19.3	.29	9.65	76	100	298	3.88	17.0
2	1	0	100	6.8	13.8	4.22	8.95	5,274	39	1,923	119	2.89
	2	28	429	23.0	17.7	.66	10.07	930	219	1,288	89.7	70.3
	3	56	603	33.8	16.8	.49	10.86	375	289	1,329	50.5	263
	4	28	420	22.4	17.8	.51	10.28	472	277	965	44.3	86.3
	5	9	290	14.2	19.4	.58	9.37	201	152	755	13.0	32.7
	6	28	425	22.3	18.1	.41	10.19	541	264	790	51.3	83.1
	7	84	747	42.0	16.8	.35	10.97	403	1,471	1,173	67.6	819
	8	28	417	21.3	18.6	.21	10.13	333	285	389	31.0	88.1
	9	0	225	11.0	19.5	.30	9.57	69	104	305	3.49	17.4
3	1	0	106	6.8	14.6	1.62	11.43	736	53	769	17.3	4.10
	2	28	424	22.0	18.3	.51	10.11	333	227	968	31.2	70.7
	3	56	587	32.3	17.2	.25	10.89	333	686	661	43.7	299
	4	28	403	20.8	18.4	.34	10.12	444	260	619	39.9	77.5
	5	9	308	14.6	20.1	.22	9.40	222	148	302	15.3	33.7
	6	28	434	22.0	18.7	.21	10.03	416	272	406	40.4	87.6
	7	84	738	41.7	16.7	.35	11.07	416	1,578	1,154	68.7	865
	8	28	408	20.8	18.6	.21	10.13	291	285	380	26.5	86.1
	9	0	228	11.0	19.7	.30	9.58	69	113	295	3.49	18.9
4	1	0	106	6.8	14.6	1.62	11.43	736	53	769	17.3	4.10
	2	28	423	21.3	18.8	.21	10.04	583	251	392	54.7	78.2
	3	56	586	32.2	17.2	.21	10.89	354	729	566	46.4	318
	4	28	418	21.2	18.7	.22	10.13	403	280	404	37.3	86.2
	5	9	293	14.0	20.0	.25	9.39	194	141	337	12.7	30.8
	6	28	408	21.2	18.2	.44	10.10	583	278	805	52.9	83.7
	7	84	734	41.2	16.8	.38	10.97	403	1,475	1,265	66.1	804
	8	28	409	21.0	18.5	.32	9.91	333	291	606	30.9	89.5
	9	0	227	11.0	19.6	.29	9.67	67	107	293	3.35	17.9

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	30.2	g/bhp-hr
BSHC	1.62	g/bhp-hr
$BSNO_2$	6.18	g/bhp-hr
BSFC	.750	lb/bhp-hr

==Test Conditions==

Barometer 749 mmHg
Humidity 67.9 grains H_2O/lb dry air
Inlet air temperature 76° F

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* NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE D-8. - Emissions (upstream of catalysts) for gasoline engine at 916 engine hours and 851 hours on emission controls

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2*
1	1	0	108	7.2	14.0	4.23	7.83	9,108	24	2,155	229	1.98
	2	28	464	24.0	18.3	.95	9.60	2,200	271	1,942	222	91.1
	3	56	600	31.8	17.9	.25	10.72	841	760	661	110	329
	4	28	439	21.8	19.1	.32	9.95	782	303	609	74.7	96.1
	5	9	266	13.0	19.5	.42	9.57	156	125	495	9.20	24.5
	6	28	440	22.4	18.6	.73	9.72	1,721	309	1,408	165	98.1
	7	84	769	42.0	17.3	.62	10.90	655	1,400	2,072	108	765
	8	28	406	20.2	19.1	.29	10.05	430	368	514	38.0	108
	9	0	197	10.1	18.5	.17	10.76	147	78	144	6.15	10.8
2	1	0	108	7.2	14.0	4.23	7.83	9,108	24	2,155	229	1.98
	2	28	442	22.8	18.4	.74	10.01	1,369	322	1,429	130	102
	3	56	595	31.2	18.1	.29	10.73	597	846	740	76.3	359
	4	28	427	21.2	19.1	.41	10.05	528	326	766	48.3	98.8
	5	9	282	13.3	20.2	.37	9.40	176	150	463	10.8	30.8
	6	28	446	22.7	18.6	.65	10.02	1,213	325	1,248	116	103
	7	84	774	42.2	17.3	.51	11.02	548	1,503	1,697	90.6	825
	8	28	418	21.0	18.9	.38	10.15	509	366	688	45.8	110
	9	0	201	10.2	18.7	.17	10.67	137	88	147	5.84	12.4
3	1	0	100	6.8	13.8	3.88	9.92	3,130	35	1,714	68.4	2.57
	2	28	434	22.2	18.5	.65	9.92	1,174	333	1,232	111	104
	3	56	597	31.3	18.1	.30	10.73	567	855	765	72.7	364
	4	28	418	21.2	18.7	.53	10.14	685	334	960	61.4	99.2
	5	9	291	13.8	20.1	.33	9.40	156	159	435	10.0	33.9
	6	28	432	21.8	18.8	.55	10.03	861	369	1,028	79.8	114
	7	84	776	42.0	17.5	.44	11.02	479	1,611	1,462	79.3	885
	8	28	409	20.2	19.2	.23	10.06	352	409	420	31.2	120
	9	0	204	10.2	19.0	.15	10.57	147	98	133	6.33	14.1
4	1	0	100	6.8	13.8	3.88	9.92	3,130	35	1,714	68.4	2.57
	2	28	430	22.0	18.6	.65	10.13	1,213	317	1,197	111	96.6
	3	56	594	31.0	18.1	.29	10.73	567	870	735	72.0	367
	4	28	416	21.2	18.6	.48	10.13	821	339	881	73.8	101
	5	9	299	14.0	20.3	.32	9.41	196	168	418	12.8	36.4
	6	28	426	21.5	18.8	.53	10.14	978	325	971	88.6	97.7
	7	84	777	42.0	17.5	.50	10.91	587	1,576	1,677	97.5	869
	8	28	407	20.0	19.3	.29	9.96	372	368	514	32.8	108
	9	0	207	10.2	19.3	.15	10.17	186	86	139	8.32	12.8

Composite Cycle Emissions
9-mode cycle

BSCO	39.9	g/bhp-hr
BSHC	2.92	g/bhp-hr
$BSNO_2$	6.87	g/bhp-hr
BSFC	.735	lb/bhp-hr

Test Conditions

Barometer 739.8 mmHg
Humidity 48.0 grains H_2O/lb dry air
Inlet air temperature 77° F

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*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE D-9. - Emissions (upstream of catalysts) for gasoline engine at 1,045 engine hours and 980 hours on emission controls

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2*
1	1	0	104	6.0	16.3	1.94	10.06	1,452	53	880	32.5	3.93
	2	28	488	25.0	18.5	.99	9.51	2,656	246	2,103	280	86.2
	3	56	636	33.8	17.8	.36	10.93	591	538	976	79.8	241
	4	28	448	22.0	19.4	.38	9.97	830	296	733	79.4	93.9
	5	9	329	15.0	20.9	.36	9.06	830	121	527	59.4	28.7
	6	28	475	24.2	18.6	.68	9.92	1,909	284	1,403	194	95.8
	7	84	785	44.0	16.8	.64	11.31	639	1,158	2,146	106	639
	8	28	445	21.8	19.4	.32	9.97	508	294	611	48.6	93.4
	9	0	199	9.3	20.4	.17	9.61	384	74	150	16.5	10.6
2	1	0	104	6.0	16.3	1.94	10.06	1,452	53	880	32.5	3.93
	2	28	471	24.0	18.6	.76	10.02	1,660	283	1,534	165	93.4
	3	56	637	33.7	17.9	.31	10.94	353	569	857	47.8	256
	4	28	446	22.5	18.8	.51	10.14	1,038	296	983	98.5	93.4
	5	9	325	14.8	21.0	.35	9.06	519	116	509	36.8	27.2
	6	28	464	23.6	18.6	.68	10.02	1,556	293	1,360	153	96.0
	7	84	790	43.0	17.4	.46	11.24	540	1,142	1,554	89.6	629
	8	28	429	21.0	19.4	.36	10.18	374	313	657	33.7	93.6
	9	0	196	8.9	21.0	.19	9.35	415	74	163	17.5	10.3
3	1	0	109	6.2	16.6	1.30	11.76	1,120	51	562	23.9	3.63
	2	28	462	23.0	19.1	.67	9.86	1,328	286	1,320	130	93.2
	3	56	637	33.3	18.1	.31	10.96	274	556	847	36.6	247
	4	28	445	22.2	19.1	.48	10.16	685	300	908	64.5	93.8
	5	9	329	14.8	21.2	.36	9.07	436	123	509	30.9	28.9
	6	28	450	22.3	19.2	.59	10.06	1,038	287	1,115	97.7	89.6
	7	84	784	43.2	17.1	.54	11.34	540	1,264	1,801	88.7	689
	8	28	438	21.0	19.8	.33	9.99	363	314	622	33.4	95.8
	9	0	191	8.5	21.5	.17	9.27	394	79	143	16.0	10.7
4	1	0	109	6.2	16.6	1.30	11.76	1,120	51	562	23.9	3.63
	2	28	458	22.5	19.3	.69	9.86	1,349	281	1,324	129	89.0
	3	56	633	33.0	18.2	.29	11.08	270	601	761	35.5	262
	4	28	437	21.5	19.3	.44	10.17	685	287	816	62.5	86.9
	5	9	340	15.0	21.7	.36	9.09	622	125	515	44.5	29.7
	6	28	443	22.0	19.1	.65	10.16	1,141	278	1,198	104	84.3
	7	84	796	43.2	17.4	.51	11.36	560	1,288	1,688	92.0	703
	8	28	430	20.5	20.0	.32	10.00	405	314	575	36.4	93.6
	9	0	193	8.5	21.7	.19	9.28	519	83	157	21.0	11.1

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	31.8	g/bhp-hr
BSHC	2.19	g/bhp-hr
$BSNO_2$	5.41	g/bhp-hr
BSFC	.749	lb/bhp-hr

==Test Conditions==

Barometer 744.4 mmHg
Humidity 64.5 grains H_2O/lb dry air
Inlet air temperature 77°F

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*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE D-10. - Emissions (upstream of catalysts) for gasoline engine at 1,067 engine hours and 1,002 hours on emission controls

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2*
1	1	0	126	6.3	18.9	1.04	9.84	689	53	550	18.0	4.56
	2	28	459	22.7	19.2	.65	9.75	3,936	217	1,252	376	68.8
	3	56	635	32.4	18.6	.30	10.88	551	585	784	72.1	254
	4	28	445	21.7	19.5	.52	9.97	846	281	985	78.7	86.9
	5	9	345	15.0	22.0	.36	8.92	433	121	526	31.6	29.3
	6	28	441	21.5	19.5	.55	9.97	964	281	1,022	88.5	85.8
	7	84	805	43.2	17.6	.50	11.38	551	1,264	1,688	90.4	689
	8	28	428	21.0	19.4	.47	10.17	492	302	845	43.8	89.5
	9	0	176	7.2	23.4	.26	7.73	8,856	73.8	192	326	9.02
2	1	0	126	6.3	18.9	1.04	9.84	689	53	550	18.0	4.56
	2	28	452	22.1	19.4	.55	10.07	1,023	298	1,040	95.7	92.6
	3	56	617	31.8	18.4	.48	10.75	630	610	1,228	80.5	259
	4	28	436	21.4	19.4	.44	10.07	551	315	821	50.6	96.2
	5	9	329	14.2	22.2	.32	8.92	413	121	449	28.7	27.9
	6	28	441	22.2	18.8	.57	10.35	718	314	1,050	65.8	95.7
	7	84	799	42.8	17.7	.47	11.26	492	1,317	1,576	81.1	721
	8	28	422	21.0	19.1	.38	10.47	295	136	670	25.8	39.6
	9	0	186	7.3	24.4	.25	7.10	10,000	69.7	200	397	9.18
3	1	0	123	6.2	18.8	.65	10.35	453	59.4	333	11.54	5.03
	2	28	447	22.0	19.3	.51	10.17	817	292	963	75.7	89.9
	3	56	596	30.8	18.3	.48	10.75	590	644	1,190	73.0	264.7
	4	28	446	21.8	19.4	.43	10.18	541	324	812	50.2	99.7
	5	9	345	15.0	22.0	.30	9.10	551	142	439	39.7	34.0
	6	28	446	21.7	19.5	.47	10.18	669	303	872	61.4	97.3
	7	84	814	44.0	17.5	.53	11.37	551	1,390	1,777	92.1	771
	8	28	435	21.0	19.7	.37	10.08	335	324	680	30.4	97.8
	9	0	188	7.4	24.4	.25	7.10	9,348	69.7	204	379	9.38
4	1	0	123	6.2	18.8	.65	10.35	453	59.4	333	11.54	5.03
	2	28	449	22.0	19.4	.51	10.18	905	290	946	83.8	89.1
	3	56	626	31.7	18.7	.27	10.77	403	696	707	52.3	300
	4	28	435	21.0	19.7	.38	10.08	492	316	695	44.6	95.0
	5	9	343	14.8	22.2	.30	8.92	512	130	442	37.1	31.1
	6	28	455	21.8	19.8	.35	10.10	590	316	671	55.5	98.8
	7	84	799	42.7	17.7	.46	11.27	472	1,371	1,544	77.6	749
	8	28	426	20.8	19.5	.42	10.18	335	334	745	29.7	98.5
	9	0	170	7.3	22.4	.23	6.96	19,824	69.2	167	716	8.29

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	27.6	g/bhp-hr
BSHC	4.30	g/bhp-hr
$BSNO_2$	5.81	g/bhp-hr
BSFC	.726	lb/bhp-hr

==Test Conditions==

Barometer 743.5 mmHg
Humidity 59.6 grains H_2O/lb dry air
Inlet air temperature 72°F

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*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE D-11. - Emissions (upstream of catalysts) for gasoline engine at 1,117 engine hours and 1,052 hours on emission controls

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2*
1	1	0	109	5.0	20.8	0.33	8.87	906	45	162	22.1	3.69
	2	28	496	25.5	18.4	.38	10.01	824	153	842	91.0	56.0
	3	56	600	33.0	17.2	.47	10.67	742	522	1,273	99.1	231
	4	28	475	24.0	18.8	.19	10.03	391	182	405	41.5	64.0
	5	9	350	16.2	20.6	.15	9.23	577	96	243	44.9	24.8
	6	28	457	23.5	18.5	.29	10.19	402	173	592	41.0	58.5
	7	84	753	43.8	16.2	.71	11.02	618	135	2,434	104	635
	8	28	434	22.5	18.3	.21	10.31	206	215	404	19.9	69.3
	9	0	236	10.0	22.6	.20	8.12	2,390	84	216	127	14.7
2	1	0	109	5.0	20.8	.33	8.87	906	45	162	22.1	3.69
	2	28	66	24.0	18.4	.30	10.12	453	181	641	47.1	62.6
	3	56	608	33.5	17.1	.37	10.66	494	607	1,035	67.7	276
	4	28	449	23.0	18.5	.22	10.12	247	207	438	24.9	69.3
	5	9	359	16.5	20.7	.14	9.15	556	105	221	44.6	27.9
	6	28	473	23.5	19.1	.17	9.85	319	191	367	33.8	67.1
	7	84	754	44.0	16.1	.64	11.02	546	1,252	2,218	93.0	708
	8	28	448	22.5	18.9	.15	9.94	222	216	312	22.4	72.5
	9	0	246	10.5	22.4	.18	8.21	2,472	88	204	136	16.1
3	1	0	110	5.0	20.9	.33	8.68	680	55	165	17.0	4.57
	2	28	483	23.5	19.6	.30	7.93	330	189	778	42.6	81.1
	3	56	600	33.0	17.2	.37	10.67	453	633	1,020	61.2	284
	4	28	453	23.2	18.5	.22	10.12	227	220	460	23.0	74.2
	5	9	349	16.0	20.8	.14	9.05	453	108	217	35.6	28.1
	6	28	459	23.5	18.5	.22	10.12	288	207	466	29.6	70.7
	7	84	754	43.6	16.3	.63	11.03	474	1,275	2,142	80.1	715
	8	28	458	23.0	18.9	.14	9.94	185	229	301	19.1	78.6
	9	0	247	10.5	22.5	.17	8.12	2,266	97	197	127	18.0
4	1	0	110	5.0	20.9	.33	8.68	680	55	165	17.0	4.57
	2	28	458	23.5	18.5	.29	10.01	433	192	598	44.6	65.9
	3	56	592	32.6	17.2	.37	10.66	474	637	1,008	63.2	282
	4	28	461	23.5	18.6	.21	10.02	237	210	434	24.6	72.5
	5	9	359	16.5	20.8	.15	9.05	721	109	237	58.2	29.3
	6	28	463	24.0	18.3	.29	10.11	299	211	605	31.2	73.2
	7	84	758	43.8	16.3	.59	10.93	494	1,275	2,055	84.8	727
	8	28	459	23.0	19.0	.14	9.84	185	229	304	19.3	79.1
	9	0	253	10.5	23.1	.18	7.47	2,596	102	223	156	20.3

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	22.4	g/bhp-hr
BSHC	2.12	g/bhp-hr
$BSNO_2$	5.45	g/bhp-hr
BSFC	.764	lb/bhp-hr

==Test Conditions==

Barometer 741 mmHg
Humidity 64.0 grains H_2O/lb dry air
Inlet air temperature 74° F

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*NO_x data corrected to 75 grains H_2O/lb humidity.

TABLE D-12. - Emissions (upstream of catalysts) for gasoline engine at 1,118 engine hours and 1,053 hours on emission controls

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2*
1	1	0	110	5.0	21.0	0.36	8.88	886	50	179	21.5	4.03
	2	28	476	24.5	18.4	.36	10.12	690	155	765	72.7	54.4
	3	56	589	32.3	17.3	.40	10.67	762	586	1,064	100	256
	4	28	460	23.5	18.6	.26	10.13	412	181	538	42.1	61.6
	5	9	344	16.0	20.5	.16	9.33	639	98.6	251	48.5	74.9
	6	28	455	23.5	18.4	.33	10.21	505	190	675	50.8	63.4
	7	84	751	43.5	16.3	.71	11.03	680	1,264	2,388	114	702
	8	28	441	22.2	18.9	.17	10.14	144	199	337	14.0	64.4
	9	0	239	10.2	22.4	.19	8.29	2,966	88.0	205	156	15.4
2	1	0	110	5.0	21.0	.36	8.88	886	50	179	21.5	4.03
	2	28	462	23.8	18.4	.34	10.12	546	181	708	56.1	61.8
	3	56	583	32.0	17.2	.38	10.89	567	676	991	72.7	288
	4	28	452	23.0	18.7	.23	10.34	288	214	447	78.4	70.1
	5	9	349	16.0	20.8	.16	9.24	865	112	239	66.2	28.4
	6	28	446	23.0	18.4	.29	10.32	350	214	569	34.3	69.6
	7	84	749	43.5	16.2	.64	11.26	556	1,306	2,151	91.8	716
	8	28	444	22.5	18.7	.16	10.34	206	251	317	20.0	80.7
	9	0	242	10.3	22.4	.18	8.38	2,719	101	196	144	17.8
3	1	0	105	4.8	20.8	.31	9.05	659	61.2	144	15.2	4.70
	2	28	456	23.5	18.4	.29	10.32	453	190	581	45.3	63.1
	3	56	577	31.8	17.2	.37	10.88	494	684	941	63.1	290
	4	28	446	23.0	18.4	.76	10.32	258	729	517	25.4	74.7
	5	9	353	16.3	20.7	.15	9.23	639	114	230	50.0	29.5
	6	28	467	23.2	19.1	.17	9.95	330	205	359	34.2	70.7
	7	84	737	43.1	16.1	.67	11.25	556	1,332	2,213	90.8	722
	8	28	442	22.3	18.8	.17	10.24	206	242	335	20.0	78.0
	9	0	241	10.3	22.4	.18	8.30	3,131	101	197	167	17.9
4	1	0	105	4.8	20.8	.31	9.05	659	61.2	144	15.2	4.70
	2	28	443	23.0	18.3	.32	10.31	433	198	637	42.3	64.3
	3	56	576	31.8	17.1	.36	11.0	515	694	910	65.1	292
	4	28	460	23.0	19.0	.17	10.15	268	216	349	27.0	72.4
	5	9	346	16.0	20.6	.14	9.33	659	114	210	50.1	28.7
	6	28	460	23.0	19.0	.17	10.15	340	206	348	34.3	68.9
	7	84	747	43.5	16.1	.65	11.25	536	1,325	2,179	88.5	727
	8	28	448	22.6	18.8	.15	10.24	175	225	304	17.2	73.5
	9	0	245	10.4	22.6	.18	8.21	3,296	96.9	200	178	17.4

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	22.8	g/bhp-hr
BSHC	2.30	g/bhp-hr
$BSNO_2$	5.56	g/bhp-hr
BSFC	.750	lb/bhp-hr

==Test Conditions==

Barometer 741.0mmHg
Humidity 64.0 grains H_2O/lb dry air
Inlet air temperature 74° F

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*NO_x data are corrected to 75 grains H_2O/lb humidity.

APPENDIX E.--EMISSION DATA FROM THE DURABILITY TESTS OF THE GASOLINE ENGINE WITH EXHAUST SAMPLED DOWNSTREAM OF CATALYTIC CONVERTERS

TABLE E-1. - Emissions (downstream of catalysts) for gasoline engine at 251 engine hours and 186 hours on emission controls

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2*
1	1	0	130	6.1	20.4	0.17	9.45	344	51	98.3	9.86	4.83
	2	28	508	24.7	19.6	.03	9.91	447	253	78.0	50.1	94.1
	3	56	670	35.2	18.0	.02	10.81	118	684	45.8	17.4	335
	4	28	454	22.0	19.6	.01	9.92	91	284	20.9	9.14	94.7
	5	9	360	16.0	21.5	.008	9.08	118	146	12.8	9.41	38.7
	6	28	487	23.7	19.5	.01	9.96	121	318	24.2	13.0	114
	7	84	810	45.2	16.9	.04	11.32	139	1,641	135	25.1	983
	8	28	443	21.6	19.5	.009	9.97	68	319	18.1	6.67	104
	9	0	261	11.0	22.7	.008	8.57	144	131	9.58	8.36	25.4
2	1	0	130	6.1	20.4	.17	9.45	344	51	98.3	9.86	4.83
	2	28	478	23.2	19.6	.01	10.32	141	277	21.5	14.3	93.5
	3	56	652	34.2	18.1	.01	10.83	62	717	32.9	8.87	341
	4	28	428	20.8	19.6	.009	9.98	69	310	16.9	6.51	97.3
	5	9	350	16.0	20.9	.007	9.91	106	154	9.94	7.75	37.3
	6	28	458	23.0	18.9	.01	10.39	71	336	20.8	7.12	112
	7	84	797	44.2	17.0	.03	11.56	118	1,903	102	20.4	1,090
	8	28	449	22.0	19.4	.009	10.14	51	346	17.2	5.01	113
	9	0	261	11.1	22.5	.007	8.67	126	130	8.47	7.30	25.1
3	1	0	128	6.2	19.7	.008	9.98	45	62	4.73	1.27	5.80
	2	28	461	22.7	19.3	.001	10.60	118	283	18.9	11.4	91.3
	3	56	656	34.8	17.8	.01	11.12	59	764	36.1	8.36	359
	4	28	468	23.3	19.1	.01	10.36	60	372	21.5	6.11	126
	5	9	381	17.2	21.2	.007	9.29	92	159	11.9	7.71	44.3
	6	28	471	24.0	18.6	.01	10.55	68	375	26.7	7.00	128
	7	84	761	42.0	17.1	.03	11.37	85	1,441	103.	14.2	799
	8	28	445	23.3	18.1	.01	10.86	47	462	22.3	4.57	149
	9	0	263	11.3	22.3	.007	8.73	76	139	8.77	4.45	27.1
4	1	0	128	6.2	19.7	.008	9.98	45	62	4.73	1.27	5.80
	2	28	463	22.3	19.8	.009	9.99	97	266	18.1	9.81	89.4
	3	56	619	33.3	17.6	.02	11.14	52	736	52.0	7.03	331
	4	28	462	24.5	17.9	.02	10.97	177	474	47.6	17.9	159
	5	9	286	12.7	21.5	.007	9.08	35	170	8.64	2.22	35.8
	6	28	480	24.6	18.5	.01	10.33	68	388	22.3	7.33	139
	7	84	782	43.2	17.1	.03	11.48	82	1,600	102	13.9	904
	8	28	448	23.2	18.3	.01	10.75	39	423	21.8	3.81	137
	9	0	264	11.4	22.2	.007	8.73	100	144	8.63	5.91	28.2

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	1.37	g/bhp-hr
BSHC	.33	g/bhp-hr
$BSNO_2$	7.35	g/bhp-hr
BSFC	.781	lb/bhp-hr

==Test Conditions==

Barometer 753.3 mmHg
Humidity 69.8 grains H_2O/lb dry air
Inlet air temperature 77° F

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*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE E-2. - Emissions (downstream of catalysts) for gasoline engine at 374 engine hours and 309 hours on emission controls

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2 *
1	1	0	113	5.2	20.7	0.24	9.24	945	52	122	23.3	4.30
	2	28	473	23.6	19.0	.15	10.15	581	260	309	60.0	89.3
	3	56	614	33.8	17.2	.09	11.28	234	667	247	31.5	298
	4	28	458	22.4	19.5	.01	10.02	157	310	26.4	15.9	104
	5	9	336	15.0	21.4	.007	9.22	127	156	10.8	9.35	38.1
	6	28	439	22.3	18.7	.02	10.50	161	346	46.1	15.4	110
	7	84	794	46.5	16.1	.29	11.83	275	1,222	1,007	47.7	704
	8	28	416	21.2	18.6	.02	10.45	111	398	34.3	10.2	121
	9	0	247	10.3	22.9	.009	8.49	375	137	9.46	20.5	24.8
2	1	0	113	5.2	20.7	.24	9.24	945	52	122	23.3	4.30
	2	28	417	19.9	20.0	.02	9.84	194	240	33.6	17.7	72.4
	3	56	597	33.0	17.1	.06	11.33	177	698	171	23.2	304
	4	28	427	21.8	18.6	.02	10.55	119	396	39.4	11.1	122
	5	9	344	15.3	21.5	.006	9.13	102	160	9.02	7.74	40.0
	6	28	427	21.7	18.7	.02	10.50	127	378	37.2	11.9	117
	7	84	773	45.3	16.1	.26	11.83	206	1,211	910	34.9	682
	8	28	442	21.8	19.3	.01	10.17	93	374	24.8	9.02	120
	9	0	242	10.3	22.6	.007	8.65	139	141	7.48	7.48	25.2
3	1	0	102	4.9	20.0	.008	9.84	133	51	3.85	2.99	3.74
	2	28	479	22.8	20.0	.02	10.69	178	314	47.5	17.1	100
	3	56	584	32.6	16.9	.08	11.26	166	707	223	21.6	305
	4	28	445	21.7	19.5	.009	10.07	99	331	18.1	9.65	107
	5	9	330	14.7	21.4	.005	9.18	76	158	7.62	5.51	38.0
	6	28	451	22.0	19.5	.01	10.07	113	313	19.2	11.2	103
	7	84	763	44.7	16.1	.24	11.83	206	1,233	806	34.5	686
	8	28	432	21.3	19.3	.01	10.12	87	356	18.5	8.29	113
	9	0	246	10.2	23.1	.007	8.53	242	133	8.05	13.1	23.6
4	1	0	102	4.9	20.0	.008	9.84	133	51	3.85	2.99	3.74
	2	28	444	22.2	19.0	.02	10.58	174	295	42.5	16.5	92.6
	3	56	614	33.8	17.2	.03	11.34	109	710	74.0	14.7	317
	4	28	445	21.7	19.5	.009	10.02	99	326	18.2	9.71	106
	5	9	333	14.8	21.5	.005	9.18	97	165	7.66	7.08	39.9
	6	28	429	21.4	19.1	.01	10.31	124	340	26.8	11.6	106
	7	84	762	44.8	16.0	.22	11.94	260	1,249	742	43.3	691
	8	28	432	21.3	19.3	.01	10.17	133	358	18.5	12.6	113
	9	0	243	10.3	22.6	.006	8.70	163	128	7.01	8.73	22.8

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	5.38	g/bhp-hr
BSHC	.62	g/bhp-hr
$BSNO_2$	6.04	g/bhp-hr
BSFC	.750	lb/bhp-hr

==Test Conditions==

Barometer 734.5 mmHg
Humidity 64.6 grains H_2O/lb dry air
Inlet air temperature 74° F

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*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE E-3. - Emissions (downstream of catalysts) for gasoline engine at 440 engine hours and 375 hours on emission controls

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2*
1	1	0	129	6.2	19.7	0.15	9.72	357	43	85.3	10.1	4.07
	2	28	488	24.6	18.9	.18	10.3	449	188	269	47.6	66.2
	3	56	616	34.0	17.1	.08	11.5	229	650	223	30.4	287
	4	28	446	23.0	18.4	.03	10.6	138	311	58.5	13.5	101
	5	9	355	16.1	21.0	.009	9.35	144	130	13.6	11.2	33.8
	6	28	454	23.0	18.8	.02	10.4	144	263	50.8	14.4	87.3
	7	84	795	46.8	16.0	.43	11.9	222	1,136	1,490	38.0	646
	8	28	466	23.2	19.1	.02	10.2	108	280	32.2	11.1	95.8
	9	0	259	11.2	22.2	.01	8.82	109	103	13.3	6.26	19.6
2	1	0	129	6.2	19.7	.15	9.72	357	43	85.3	10.1	4.07
	2	28	466	23.8	18.6	.03	10.7	161	240	68.8	16.1	79.9
	3	56	597	33.0	17.1	.07	11.4	141	645	186	18.3	278
	4	28	461	22.8	19.2	.01	10.2	121	265	25.0	12.2	89.0
	5	9	332	15.0	21.1	.007	9.26	98	131	10.1	7.19	31.8
	6	28	433	22.2	18.5	.02	10.6	109	305	42.9	10.3	95.3
	7	84	768	45.4	15.9	.37	12.1	190	1,136	1,241	31.4	624
	8	28	440	22.0	19.0	.01	10.3	79	274	26.7	7.63	88.0
	9	0	257	11.1	22.1	.009	8.87	104	103	10.3	5.9	19.36
3	1	0	118	5.8	19.3	.008	10.2	76	52	4.31	1.95	4.48
	2	28	450	23.0	18.6	.02	10.6	138	286	45.3	13.5	92.7
	3	56	591	32.8	17.0	.07	11.5	138	641	187	17.7	274
	4	28	426	22.0	18.4	.02	10.6	88	345	36.6	8.27	108
	5	9	339	15.3	21.1	.006	9.26	75	134	8.95	5.61	33.3
	6	28	447	22.6	18.8	.02	10.3	115	289	35.4	11.4	94.9
	7	84	766	45.0	16.0	.30	11.9	173	1,161	1,016	28.8	642
	8	28	453	22.6	19.0	.01	10.3	69	289	27.1	6.85	95.2
	9	0	257	11.1	22.2	.008	8.73	86	107	9.04	4.95	20.5
4	1	0	118	5.8	19.3	.008	10.2	76	52	4.31	1.95	4.48
	2	28	477	23.0	18.4	.02	10.7	127	269	44.0	12.3	86.4
	3	56	583	32.5	16.9	.07	11.5	127	658	174	16.1	277
	4	28	419	22.0	18.1	.02	10.9	92	384	43.1	8.40	116
	5	9	344	15.6	21.1	.006	9.30	81	136	9.50	6.15	34.4
	6	28	431	22.3	18.3	.02	10.7	97	353	42.9	9.15	110
	7	84	761	44.4	16.1	.24	11.9	150	1,190	809	24.7	652
	8	28	438	22.0	18.9	.02	10.3	68	278	31.5	6.54	88.9
	9	0	253	11.0	22.0	.01	8.92	81	109	10.8	4.52	20.2

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	6.46	g/bhp-hr
BSHC	.45	g/bhp-hr
$BSNO_2$	5.52	g/bhp-hr
BSFC	.771	lb/bhp-hr

==Test Conditions==

Barometer 745 mmHg
Humidity 57.8 grains H_2O/lb dry air
Inlet air temperature 73° F

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*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE E-4. - Emissions (downstream of catalysts) for gasoline engine at 583 engine hours and 518 hours on emission controls

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2 *
1	1	0	117	5.7	19.6	0.12	9.83	280	45	62.9	7.26	3.89
	2	28	470	23.5	19.0	.10	10.25	646	255	214	66.1	76.6
	3	56	601	32.2	17.6	.03	10.96	256	692	91.1	33.9	305
	4	28	448	22.2	19.2	.02	10.06	215	304	37.6	21.4	101
	5	9	329	15.0	21.0	.01	9.21	151	142	15.7	11.1	34.7
	6	28	453	22.3	19.3	.02	9.96	258	298	42.5	26.1	100
	7	84	767	42.5	17.0	.11	11.21	400	1,648	378	67.8	929
	8	28	430	21.5	19.0	.03	10.04	194	330	54.3	18.7	106
	9	0	252	11.0	21.9	.02	8.81	167	141	17.3	9.42	26.4
2	1	0	117	5.7	19.6	.12	9.83	280	45	62.9	7.26	3.89
	2	28	455	22.2	19.5	.02	10.04	247	292	36.3	24.7	97.0
	3	56	595	32.0	17.6	.04	11.14	247	761	111	32.0	327
	4	28	440	21.7	19.3	.02	10.06	221	332	35.0	21.5	107
	5	9	321	14.5	21.2	.01	9.17	129	156	13.8	9.23	37.1
	6	28	446	21.8	19.5	.02	10.07	241	328	37.6	23.6	106
	7	84	756	42.0	17.0	.10	11.41	312	1,691	316	51.5	928
	8	28	420	20.8	19.2	.02	10.06	151	347	37.0	14.1	108
	9	0	252	11.0	21.9	.01	8.81	140	144	14.9	7.90	27.1
3	1	0	107	5.2	19.5	.01	9.98	84	54	3.66	1.98	4.22
	2	28	446	21.7	19.5	.02	10.01	258	296	32.0	25.2	96.2
	3	56	596	32.0	17.6	.05	11.04	212	796	124	27.7	346
	4	28	430	21.2	19.3	.02	10.06	187	332	35.9	17.8	105
	5	9	311	14.0	21.2	.01	9.13	140	164	13.7	9.71	37.8
	6	28	441	21.5	19.5	.02	10.01	215	320	33.3	20.9	103
	7	84	754	41.8	17.0	.10	11.33	312	1,695	317	51.6	932
	8	28	424	21.0	19.2	.02	10.13	156	347	39.9	14.6	108
	9	0	253	11.0	22.0	.01	8.82	105	148	14.9	5.93	27.7
4	1	0	107	5.2	19.5	.01	9.98	84	54	3.66	1.98	4.22
	2	28	445	21.7	19.5	.02	10.04	228	305	33.5	22.3	98.8
	3	56	591	31.5	17.7	.04	10.93	194	768	97.9	25.2	332
	4	28	433	21.3	19.3	.02	9.96	161	330	33.1	15.6	106
	5	9	323	14.5	21.3	.01	9.07	118	158	14.9	8.54	37.9
	6	28	434	21.2	19.5	.02	9.97	215	322	32.2	20.6	103
	7	84	753	41.8	17.0	.10	11.33	301	1,751	317	49.8	963
	8	28	425	21.0	19.2	.01	9.96	142	347	37.3	13.5	110
	9	0	253	11.0	22.0	.01	8.82	142	144	14.9	8.01	26.9

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	2.79	g/bhp-hr
BSHC	.72	g/bhp-hr
$BSNO_2$	7.19	g/bhp-hr
BSFC	.731	lb/bhp-hr

==Test Conditions==

Barometer 745.5 mmHg
Humidity 64.6 grains H_2O/lb dry air
Inlet air temperature 75° F

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*NO_x data corrected to 75 grains H_2O/lb humidity.

TABLE E-5. - Emissions (downstream of catalysts) for gasoline engine at 679 engine hours and 614 hours on emission controls

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F*	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2*
1	1	0	128	6.7	18.2	0.26	10.52	239	51	148	6.72	4.77
	2	28	465	23.0	19.2	.10	9.96	401	228	207	41.4	78.4
	3	56	617	33.2	17.6	.05	10.92	245	684	148	33.6	311
	4	28	439	22.0	18.9	.34	9.94	184	303	670	17.8	97.5
	5	9	325	14.8	20.9	.009	9.25	78	145	13.7	5.65	34.8
	6	28	448	22.2	19.2	.02	10.16	234	281	50.1	23.1	91.9
	7	84	772	42.8	17.0	.10	11.33	323	1,681	351	54.7	945
	8	28	434	21.5	19.2	.02	10.06	142	328	39.3	13.7	105
	9	0	255	11.3	21.6	.01	9.08	37	142	16.4	2.08	26.5
2	1	0	128	6.7	18.2	.26	10.52	239	51	148	6.72	4.77
	2	28	455	22.3	19.4	.02	10.18	234	250	43.3	23.2	82.2
	3	56	594	32.0	17.6	.07	11.14	200	727	178	25.9	312
	4	28	440	21.5	19.5	.02	9.97	151	310	31.8	14.7	100
	5	9	311	14.0	21.2	.01	9.17	67	168	14.8	4.63	38.6
	6	28	446	21.7	19.6	.02	9.98	161	309	32.1	15.8	101
	7	84	767	42.4	17.1	.09	11.33	245	1,747	296	41.2	975
	8	28	432	21.3	19.3	.02	10.06	120	337	38.9	11.5	107
	9	0	255	11.3	21.6	.02	9.08	53	147	19.7	2.98	27.5
3	1	0	116	6.2	17.7	.01	11.04	56	54	4.91	1.42	4.52
	2	28	454	22.0	19.6	.01	10.08	167	284	24.2	16.5	93.1
	3	56	602	32.3	17.6	.05	11.04	161	772	126	21.2	338
	4	28	437	21.3	19.5	.01	9.98	122	323	28.4	11.8	104
	5	9	323	14.5	21.3	.01	9.17	56	170	14.8	4.01	40.4
	6	28	454	22.0	19.6	.01	9.98	145	327	29.3	14.5	108
	7	84	774	42.7	17.1	.08	11.34	228	1,856	259	38.6	1,044
	8	28	431	21.0	19.5	.02	9.87	106	344	36.3	10.2	110
	9	0	257	11.3	21.7	.01	8.91	41	148	16.7	2.35	28.2
4	1	0	116	6.2	17.7	.01	11.04	56	54	4.91	1.42	4.52
	2	28	451	22.0	19.5	.02	9.97	161	310	30.9	16.1	103
	3	56	606	32.0	17.9	.03	10.84	117	740	87.3	15.6	328
	4	28	433	21.0	19.6	.01	9.88	109	321	28.3	10.5	103
	5	9	324	14.5	21.4	.008	9.07	56	179	11.9	4.05	43.0
	6	28	444	21.5	19.6	.01	9.88	134	321	28.2	13.2	105
	7	84	763	42.0	17.2	.06	11.22	200	1,726	221	33.7	966
	8	28	429	21.0	19.4	.02	10.07	104	355	32.7	9.81	111
	9	0	256	11.3	21.6	.01	8.99	45	151	13.6	2.56	28.4

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	3.19	g/bhp-hr
BSHC	.60	g/bhp-hr
$BSNO_2$	7.37	g/bhp-hr
BSFC	.746	lb/bhp-hr

==Test Conditions==

Barometer 742.4 mmHg
Humidity 69.9 grains H_2O/lb dry air
Inlet air temperature 76° F

*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE E-6. - Emissions (downstream of catalysts) for gasoline engine at 835 engine hours and 770 hours on emission controls

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2*
1	1	0	88.7	6.0	13.8	3.64	8.95	4,787	30	1,532	99.7	2.07
	2	28	433	23.8	17.2	.45	10.67	1,052	223	882	101	71.3
	3	56	624	35.2	16.7	.03	11.42	96	590	96.1	13.4	273
	4	28	417	22.3	17.7	.04	10.70	138	280	80.8	13.0	87.4
	5	9	290	14.2	19.4	.01	9.76	45	131	12.9	2.96	28.6
	6	28	428	22.7	17.8	.04	10.71	197	291	72.0	18.8	92.3
	7	84	752	44.2	16.0	.09	11.83	145	1,303	293	24.4	727
	8	28	414	21.5	18.3	.01	10.42	62	285	22.7	5.79	88.5
	9	0	188	10.0	17.8	.005	10.71	109	78	4.43	4.61	10.9
2	1	0	88.7	6.0	13.8	3.64	8.95	4,787	30	1,532	99.7	2.07
	2	28	420	22.3	17.8	.04	10.32	224	250	85.5	21.8	80.9
	3	56	602	33.9	16.8	.02	11.42	55	612	66.0	7.39	273
	4	28	398	21.3	17.7	.03	10.70	81	297	53.1	7.29	88.8
	5	9	301	14.5	19.8	.007	9.58	42	154	10.1	2.88	35.2
	6	28	416	22.2	17.7	.04	10.71	129	287	77.2	12.0	89.2
	7	84	736	43.6	15.9	.08	11.93	118	1,385	250	19.4	757
	8	28	394	21.0	17.8	.03	10.49	59	297	47.7	5.34	89.4
	9	0	183	9.5	18.2	.006	10.42	105	77	4.71	4.34	10.55
3	1	0	95.7	6.0	14.9	.16	11.71	1,091	40	71.5	24.8	3.05
	2	28	412	22.0	17.7	.04	10.70	158	286	85.5	14.6	88.0
	3	56	608	34.4	16.7	.05	11.41	53	650	140	7.21	294
	4	28	402	21.5	17.7	.03	10.70	76	310	50.7	6.90	93.5
	5	9	291	14.0	19.8	.006	9.49	30	151	7.70	2.01	33.5
	6	28	395	21.2	17.6	.03	10.92	99	301	57.3	8.68	87.8
	7	84	727	43.0	15.9	.07	11.93	121	1,402	231	19.6	756
	8	28	393	20.2	18.5	.01	10.32	43	270	18.6	3.81	79.5
	9	0	183	9.4	18.5	.004	10.22	89	69	3.70	3.71	9.58
4	1	0	95.7	6.0	14.9	.16	11.71	1,091	40	71.5	24.8	3.05
	2	28	416	22.3	17.6	.05	10.81	151	284	92.3	14.0	87.7
	3	56	591	33.8	16.5	.10	11.51	89	494	272	11.7	216
	4	28	394	21.2	17.6	.02	10.81	66	314	38.4	5.86	92.6
	5	9	292	14.0	19.9	.009	9.59	39	151	11.61	2.58	33.2
	6	28	403	21.6	17.7	.03	10.82	92	301	49.8	8.31	90.4
	7	84	736	43.8	15.8	.26	10.93	145	1,167	915	25.7	688
	8	28	391	21.0	17.6	.02	10.81	55	323	41.4	4.83	94.2
	9	0	183	9.3	18.6	.004	10.23	53	74	3.67	2.18	10.1

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	8.99	g/bhp-hr
BSHC	.77	g/bhp-hr
$BSNO_2$	5.65	g/bhp-hr
BSFC	.750	lb/bhp-hr

==Test Conditions==

Barometer 741.6 mmHg
Humidity 64.9 grains H_2O/lb dry air
Inlet air temperature 75° F

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*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE E-7. - Emissions (downstream of catalysts) for gasoline engine at 902 engine hours and 837 hours on emission controls

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2*
1	1	0	108	6.8	14.9	2.37	10.25	2,269	49	1,148	54.5	3.88
	2	28	473	24.5	18.3	.38	10.64	861	255	762	86.2	84.6
	3	56	628	33.6	17.7	.08	11.26	225	688	206	30.2	306
	4	28	420	21.2	18.8	.14	10.67	323	297	250	28.6	87.5
	5	9	298	13.8	20.6	.02	9.72	68	145	23.6	4.37	30.9
	6	28	435	22.0	18.8	.14	10.56	323	295	270	30.0	91.2
	7	84	840	46.8	16.9	.14	11.68	303	1,633	515	54.3	972
	8	28	365	18.2	19.1	.02	10.36	117	334	28.9	9.29	88.2
	9	0	172	8.5	19.2	.002	10.48	34	95	1.47	1.25	11.5
2	1	0	108	6.8	14.9	2.37	10.25	2,269	49	1,148	54.5	3.88
	2	28	441	22.5	18.6	.12	10.77	264	292	233	24.7	90.6
	3	56	624	33.2	17.8	.02	11.39	117	746	65.2	15.4	327
	4	28	416	21.0	18.8	.04	10.67	147	320	73.3	13.1	94.3
	5	9	323	15.0	20.6	.009	9.62	54	160	12.7	3.81	37.5
	6	28	435	22.0	18.8	.05	10.78	196	330	92.0	18.0	101
	7	84	810	45.0	17.0	.10	11.80	210	1,680	328	36.0	956
	8	28	406	20.0	19.3	.01	10.27	93	343	25.4	8.20	100
	9	0	205	10.0	19.5	.002	10.39	20	90	1.75	.87	13.1
3	1	0	100	6.2	15.1	.97	12.21	489	42	417	10.4	2.98
	2	28	449	22.8	18.7	.08	10.66	186	327	149	17.9	104
	3	56	621	33.2	17.7	.07	11.27	137	692	199	18.2	305
	4	28	432	22.0	18.6	.04	10.77	127	358	73.0	11.7	110
	5	9	323	15.0	20.6	.01	9.72	59	180	14.2	4.12	41.8
	6	28	438	22.2	18.7	.06	10.77	166	330	109	15.4	102
	7	84	788	43.7	17.0	.07	11.68	200	1,691	252	33.7	945
	8	28	415	21.2	18.6	.02	10.76	110	373	33.5	9.80	110
	9	0	201	9.8	19.5	.002	10.39	24	93	2.11	1.03	13.2
4	1	0	100	6.2	15.1	.97	12.21	489	42	417	10.4	2.98
	2	28	439	22.2	18.8	.03	10.67	259	332	55.5	24.3	104
	3	56	621	33.3	17.7	.10	11.38	108	784	253	14.2	342
	4	28	428	21.7	18.7	.03	10.67	127	350	60.4	11.7	107
	5	9	305	14.2	20.5	.01	9.72	49	177	13.5	3.24	38.9
	6	28	438	22.2	18.7	.04	10.77	166	344	67.4	15.4	106
	7	84	777	43.2	17.0	.08	11.79	200	1,711	265	33.0	936
	8	28	420	20.8	19.2	.01	10.37	88	351	23.5	7.99	106
	9	0	200	9.6	19.8	.002	10.20	20	97	1.72	.85	13.7

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	9.64	g/bhp-hr
BSHC	.71	g/bhp-hr
$BSNO_2$	7.08	g/bhp-hr
BSFC	.752	lb/bhp-hr

==Test Conditions==

Barometer 740.8 mmHg
Humidity 55.4 grains H_2O/lb dry air
Inlet air temperature 76° F

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*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE E-8. - Emissions (downstream of catalysts) for gasoline engine at 1,062 engine hours and 997 hours on emission controls

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2*
1	1	0	134	7.0	18.2	0.38	10.85	866	63	213	24.3	5.90
	2	28	500	25.0	19.0	.33	10.25	1,423	270	712	150	94.6
	3	56	657	34.8	17.9	.08	11.40	142	537	223	19.5	245
	4	28	481	23.0	19.9	.04	10.20	320	311	92.8	32.5	105
	5	9	352	15.7	21.5	.04	9.46	261	143	55.1	19.5	35.6
	6	28	486	23.0	20.1	.11	10.11	510	311	223	51.8	105
	7	84	822	45.0	17.3	.12	11.82	142	1,179	430	24.2	669
	8	28	466	22.5	19.7	.04	10.40	166	326	89.1	16.2	106
	9	0	211	9.2	21.9	.02	9.10	130	81	16.9	5.94	12.3
2	1	0	134	7.0	18.2	.38	10.85	866	63	213	24.3	5.90
	2	28	481	24.0	19.0	.10	10.68	605	314	210	60.7	105
	3	56	636	33.3	18.1	.06	11.30	83	552	156	11.0	244
	4	28	471	23.7	18.9	.10	10.78	380	318	206	37.4	104
	5	9	361	16.0	21.6	.05	9.38	380	143	77.8	29.1	36.5
	6	28	467	23.3	19.1	.12	10.58	593	309	234	58.3	101
	7	84	805	44.5	17.1	.12	12.04	119	1,189	409	19.7	654
	8	28	457	22.0	19.8	.04	10.30	101	327	86.7	9.74	105
	9	0	213	9.3	21.9	.14	9.29	107	81	13.2	4.85	12.1
3	1	0	128	6.6	18.4	.02	11.20	142	63	13.2	3.78	5.61
	2	28	480	23.9	19.1	.10	10.69	534	311	194	53.4	103
	3	56	643	33.8	18.0	.05	11.41	70	599	147	9.36	266
	4	28	468	22.3	20.0	.06	10.21	249	347	127	24.5	113
	5	9	340	15.0	21.7	.06	9.38	439	152	91.0	31.5	36.3
	6	28	444	22.0	19.2	.13	10.48	534	318	249	50.0	99.0
	7	84	802	44.2	17.1	.13	11.81	119	1,200	441	20.0	669
	8	28	448	21.7	19.6	.06	10.19	130	328	121	12.5	104
	9	0	210	9.2	21.8	.02	9.09	107	84	14.7	4.90	12.8
4	1	0	128	6.6	18.4	.02	11.20	142	63	13.2	3.78	5.61
	2	28	458	23.0	18.9	.10	10.46	534	300	198	52.5	98.0
	3	56	628	33.5	17.7	.07	11.15	69	539	183	9.34	242
	4	28	455	22.0	19.7	.06	9.98	178	334	121	17.7	110
	5	9	338	15.2	21.3	.06	9.26	510	143	85.1	37.5	35.0
	6	28	458	23.2	18.7	.13	10.45	474	326	255	46.9	107
	7	84	790	43.8	17.0	.12	11.56	119	1,243	406	20.2	702
	8	28	448	22.0	19.2	.06	10.27	125	347	107	12.1	111
	9	0	214	9.3	22.1	.02	9.10	101	85	14.9	4.67	13.1

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	5.90	g/bhp-hr
BSHC	.80	g/bhp-hr
$BSNO_2$	5.61	g/bhp-hr
BSFC	.771	lb/bhp-hr

==Test Conditions==

Barometer 745 mmHg
Humidity 69.6 grains H_2O/lb dry air
Inlet air temperature 76° F

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*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE E-9. - Emissions (downstream of catalysts) for gasoline engine at 1,067 engine hours and 1,002 hours on emission controls

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2 *
1	1	0	126	6.2	19.4	0.69	9.76	481	55.9	371	12.9	4.98
	2	28	473	23.0	19.6	.29	9.98	1,068	271	588	107	90.6
	3	56	650	34.0	18.1	.11	11.18	192	598	296	26.2	271
	4	28	443	21.7	19.4	.08	10.49	235	310	152	21.8	95.7
	5	9	336	14.6	22.0	.04	9.20	171	130	52.9	12.2	30.9
	6	28	445	21.8	19.4	.06	10.49	246	288	119	23.0	89.5
	7	84	812	43.7	17.6	.14	11.60	182	1,274	486	30.7	713
	8	28	427	21.2	19.2	.05	10.69	123	327	97.7	11.0	97.1
	9	0	169	7.0	23.1	.16	8.50	2,478	62.2	115	88.3	7.37
2	1	0	126	6.2	19.4	.69	9.76	481	55.9	371	12.9	4.98
	2	28	447	22.2	19.1	.12	10.80	214	305	218	19.7	93.4
	3	56	617	32.0	18.3	.11	11.19	144	595	279	18.5	253
	4	28	445	21.8	19.4	.05	10.60	150	337	101	13.9	102
	5	9	338	14.7	22.0	.04	9.29	139	139	52.7	9.92	32.9
	6	28	450	22.0	19.4	.06	10.71	224	302	118	20.7	92.6
	7	84	803	43.5	17.5	.13	11.83	150	1,317	445	24.7	720
	8	28	424	21.0	19.2	.04	10.80	91	332	64.0	7.99	96.7
	9	0	171	7.0	23.4	.02	8.59	2,221	62.3	13.4	79.8	7.4
3	1	0	123	6.2	18.9	.03	10.90	101	63.6	14.0	2.60	5.43
	2	28	452	22.0	19.5	.06	10.61	267	311	119	24.9	96.2
	3	56	618	32.0	18.3	.10	11.19	134	616	256	17.2	263
	4	28	444	21.7	19.4	.05	10.49	139	332	102	13.0	103
	5	9	339	14.7	22.1	.04	9.29	128	137	52.7	9.13	32.5
	6	28	445	21.8	19.4	.07	10.60	160	323	135	14.8	99.4
	7	84	805	43.0	17.7	.12	11.61	147	1,302	419	24.4	717
	8	28	427	21.0	19.3	.05	10.60	107	332	97.8	9.56	98.5
	9	0	173	7.0	23.8	.02	8.43	2,136	62.4	13.6	78.3	7.60
4	1	0	123	6.2	18.9	.03	10.90	101	63.6	14.0	2.60	5.43
	2	28	450	21.8	19.6	.06	10.50	235	304	119	21.9	94.2
	3	56	617	31.7	18.5	.09	11.20	139	643	231	17.7	271.6
	4	28	429	21.0	19.4	.06	10.60	128	337	114	11.4	99.7
	5	9	331	14.3	22.2	.04	9.30	96	137	51.3	6.66	31.7
	6	28	450	21.8	19.7	.06	10.40	182	311	121	17.2	97.4
	7	84	805	43.0	17.7	.12	11.62	144	1,351	390	23.9	745
	8	28	436	20.7	20.1	.04	10.21	96	323	83.7	8.78	98.0
	9	0	178	7.0	24.4	.02	8.27	1,922	62.5	14.0	72.0	7.77

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	6.25	g/bhp-hr
BSHC	.92	g/bhp-hr
$BSNO_2$	5.77	g/bhp-hr
BSFC	.729	lb/bhp-hr

==Test Conditions==

Barometer 744.6 mmHg
Humidity 66.0 grains H_2O/lb dry air
Inlet air temperature 75° F

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*NO_x data are corrected to 75 grains H_2O/lb humidity.

TABLE E-10. - Emissions (downstream of catalysts) for gasoline engine at 1,115 engine hours and 1,050 hours on emission controls

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2*
1	1	0	110	5.0	21.1	0.12	9.06	468	54	58.7	11.5	4.40
	2	28	513	25.5	19.1	.07	10.05	359	190	166	40.9	71.4
	3	56	591	32.3	17.3	.15	10.90	316	606	405	41.8	266
	4	28	464	23.8	18.4	.05	10.33	158	219	113	16.4	75.5
	5	9	361	16.5	20.9	.02	9.25	228	113	29.4	18.4	30.2
	6	28	468	24.0	18.5	.04	10.33	131	206	84.9	13.7	71.7
	7	84	757	44.0	16.2	.21	11.49	239	1,227	715	40.7	693
	8	28	427	22.0	18.4	.03	10.54	76	232	58.7	7.17	72.7
	9	0	229	9.5	23.2	.02	8.23	2,176	79	19.5	111	13.3
2	1	0	110	5.0	21.1	.12	9.06	468	54	58.7	11.5	4.40
	2	28	469	24.2	18.4	.04	10.43	163	208	93.4	17.1	72.3
	3	56	594	32.8	17.1	.12	11.10	169	613	327	22.4	270
	4	28	461	23.7	18.4	.03	10.43	76	235	64.1	7.80	80.0
	5	9	362	16.5	20.9	.02	9.25	190	115	25.8	15.3	30.8
	6	28	486	24.0	19.3	.02	9.96	98	216	54.4	10.7	78.1
	7	84	763	43.8	16.4	.01	11.50	174	1,314	514	29.6	743
	8	28	444	22.8	18.5	.02	10.33	54	249	49.6	5.40	82.7
	9	0	236	9.5	23.8	.02	7.74	2,176	79	20.8	118	14.2
3	1	0	106	4.8	21.0	.02	9.25	125	61.0	7.51	2.93	4.76
	2	28	468	24.0	18.5	.03	10.33	125	206	72.5	13.1	71.9
	3	56	608	34.0	16.9	.18	11.20	152	595	490	20.6	268
	4	28	461	23.8	18.4	.03	10.53	65	247	70.5	6.64	83.6
	5	9	362	16.5	20.9	.02	9.25	131	115	30.7	10.6	30.8
	6	28	458	23.7	18.3	.03	10.53	76	229	70.2	7.73	77.4
	7	84	778	43.8	16.8	.20	9.40	174	1,360	818	36.0	933
	8	28	457	23.2	18.7	.03	10.34	54	258	66.7	5.48	87.0
	9	0	235	9.6	23.5	.02	8.07	1,958	83.7	20.2	103	14.6
4	1	0	106	4.8	21.0	.02	9.25	125	61.0	7.51	2.93	4.76
	2	28	468	24.3	18.3	.03	10.53	120	232	72.0	12.5	80.3
	3	56	599	33.3	17.0	.14	11.09	152	630	375	20.4	281
	4	28	456	23.7	18.2	.03	10.53	65	251	63.4	6.62	84.7
	5	9	362	16.5	20.9	.02	9.25	120	115	25.8	9.68	30.8
	6	28	478	23.8	19.1	.02	10.05	76	226	46.8	8.14	80.4
	7	84	758	43.3	16.5	.14	11.51	163	1,463	482	27.4	818
	8	28	447	23.2	18.3	.03	10.53	54	265	68.7	5.38	87.5
	9	0	233	9.5	23.5	.02	8.07	1,958	81.0	21.6	102	14.0

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	6.22	g/bhp-hr
BSHC	.95	g/bhp-hr
$BSNO_2$	6.22	g/bhp-hr
BSFC	.763	lb/bhp-hr

==Test Conditions==

Barometer 741.2 mmHg
Humidity 63.11 grains H_2O/lb dry air
Inlet air temperature 73° F

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*NO_x data corrected to 75 grains H_2O/lb humidity.

TABLE E-11. - Emissions (downstream of catalysts) for gasoline engine at 1,116 engine hours and 1,051 hours on emission controls

Cycle No.	Mode	Observed power, bhp	Exhaust flow, lb/hr	Fuel flow, lb/hr	A/F	Emissions						
						Volume percent		HC, ppmC	NO_x,* ppm	Grams/hr		
						CO	CO_2			CO	HC	NO_2*
1	1	0	110	5.0	21.0	0.20	9.06	597	54	98.5	14.5	4.34
	2	28	480	25.0	18.2	.32	10.31	640	184	691	67.9	64.7
	3	56	595	33.0	17.0	.19	11.10	373	606	499	49.3	266
	4	28	461	24.0	18.2	.07	10.63	149	221	147	15.1	74.6
	5	9	365	17.0	20.5	.03	9.52	107	114	44.4	8.64	30.6
	6	28	464	24.0	18.3	.05	10.53	111	213	112	11.4	72.5
	7	84	756	44.0	16.2	.23	11.61	245	1,221	781	41.2	683
	8	28	458	23.2	18.7	.04	10.34	85	235	73.6	8.61	79.0
	9	0	235	9.7	23.2	.03	8.32	2,025	80	28.7	104	13.7
2	1	0	110	5.0	21.0	.20	9.06	597	54	98.5	14.5	4.34
	2	28	475	24.5	18.4	.05	10.43	149	213	96.1	15.8	74.8
	3	56	589	32.5	17.1	.13	11.11	181	654	330	23.7	285
	4	28	451	23.5	18.2	.05	10.52	85	743	91.3	8.57	81.2
	5	9	350	16.0	20.9	.02	9.34	133	113	28.5	10.3	28.9
	6	28	463	24.0	18.3	.05	10.42	101	226	94.1	10.5	77.8
	7	84	750	44.0	16.1	.25	12.06	203	1,258	808	32.9	677
	8	28	447	23.0	18.4	.05	10.54	75	239	89.3	7.39	78.1
	9	0	230	9.6	23.0	.03	8.31	1,919	80	28.4	98.0	13.5
3	1	0	104	4.8	20.7	.01	9.43	117	61.5	4.23	2.70	4.71
	2	28	467	24.0	18.5	.04	10.33	117	208	76.2	12.2	72.6
	3	56	591	32.8	17.0	.12	11.33	165	645	326	21.4	278
	4	28	461	23.8	18.4	.04	10.54	85	252	74.0	8.67	85.3
	5	9	359	16.5	20.7	.02	9.43	171	119	29.1	13.5	31.2
	6	28	459	23.8	18.3	.04	10.53	85	247	74.0	8.68	83.8
	7	84	754	43.8	16.2	.22	11.61	181	1,303	748	30.4	726
	8	28	436	22.5	18.4	.05	10.54	64	243	87.4	6.17	77.8
	9	0	237	9.8	23.2	.02	8.32	1,812	80	19.4	94.6	13.9
4	1	0	104	4.8	20.7	.01	9.43	117	61.5	4.23	2.70	4.71
	2	28	462	23.8	18.4	.04	10.43	123	213	74.7	12.7	72.3
	3	56	595	33.0	17.0	.12	11.21	160	645	332	21.1	282
	4	28	442	23.2	18.1	.04	10.73	80	260	70.7	7.82	84.3
	5	9	359	16.5	20.8	.02	9.43	175	120	29.1	13.8	31.4
	6	28	439	23.0	18.1	.04	10.73	69	268	70.1	6.68	86.3
	7	84	747	43.5	16.2	.20	11.72	171	1,324	649	28.3	727
	8	28	430	22.5	18.1	.04	10.73	64	264	68.6	6.06	83.1
	9	0	240	9.9	23.2	.02	8.32	1,706	84	19.6	90.1	14.8

==Composite Cycle Emissions==
==9-mode cycle==

BSCO	6.80	g/bhp-hr
BSHC	1.01	g/bhp-hr
$BSNO_2$	5.56	g/bhp-hr
BSFC	.760	lb/bhp-hr

==Test Conditions==

Barometer 740.7 mmHg
Humidity 65.67 grains H_2O/lb dry air
Inlet air temperature 73° F

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*NO_x data are corrected to 75 grains H_2O/lb humidity.